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December 15, 1921

Engineering News-Record

Devoted to Civil Engineering and Contracting
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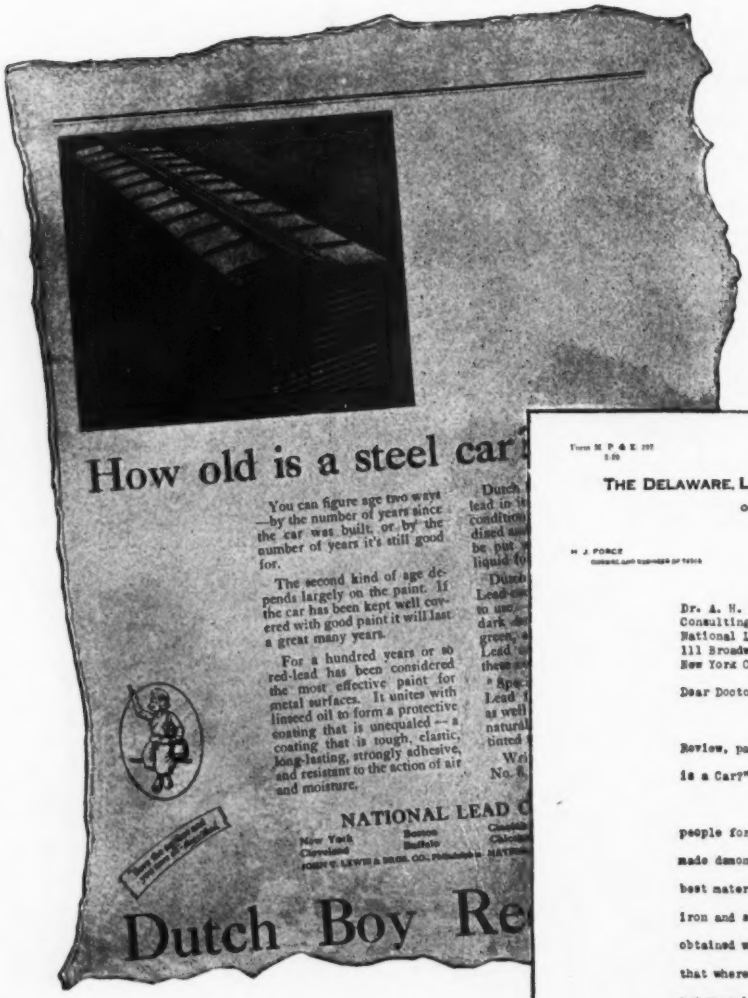
Missouri River Banks Protected by Retards of Full Sized Trees

Traveling Forms Used in Two Concrete Jobs—
A Stadium and a Grain Elevator

How Can We Train the Engineer for Industrial and Social Service?

Swiss Engineers Make Exhaustive Measurements
Of Bridge Under Load

A Prominent R. R. Chemist Says—


How old is a steel car
You can figure age two ways—by the number of years since the car was built, or by the number of years it's still good for.
The second kind of age depends largely on the paint. If the car has been kept well covered with good paint it will last a great many years.
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THE DELAWARE, LACKAWANNA & WESTERN RAILROAD COMPANY

OFFICE OF CHEMIST AND ENGINEER OF TESTS

SCRANTON, PA.

H. J. FORCE

October 11th, 1921.

File A-20

Dr. A. H. Sabin,
Consulting Chemist,
National Lead Company,
111 Broadway,
New York City, N. Y.

Dear Doctor:

I note in the October issue of the Railway Review, page 3, your advertisement entitled "How Old is a Car?"

I have recommended this practice to our people for some time. Exposure tests which we have made demonstrate without a question of doubt that the best material so far discovered for the preservation of iron and steel is red lead; and the best results were obtained where the metal was given two coats. We found that where the red lead ran above 90% red lead that there was very little difference in the results after 5 or 6 years exposure. You can not impress too much the importance of painting all steel work with red lead. This can be followed with a coat of black, but the important thing is to get the red lead on the metal as a primer.

Yours truly,

H J Force

WE could write no stronger advertisement for red-lead than Mr. Force has written unconsciously for us in his unsolicited letter.

It is only necessary for you to realize what such a recommendation means, coming as it does from the Chief Chemist and Engineer of Tests for one of our great railroads.

NATIONAL LEAD COMPANY

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

Volume 87 — NEW YORK, DECEMBER 15, 1921 — Number 24

Society Co-ordination

A STUDY of the calendar of annual meetings of engineering societies discloses the following information:

American Society of Civil Engineers, Jan. 18-19.
American Road Builders Association, Jan. 17-20.
Associated General Contractors, Jan. 17-19.

As if to make doubly sure that the attendance of engineers and contractors shall be limited to only one of these gatherings the committees in charge have not merely selected identical dates, but have chosen such widely separated centers as New York City, Cleveland, and Chicago for staging their sessions. A number of men belong to all three organizations; many hold membership in at least two. It is presumable that they would find it profitable to be present at two or, possibly, all three of the conventions. As matters now stand, however, a single choice must be made. If the Federated American Engineering Societies could only postpone for two weeks its annual meeting in Washington "co-ordination" in arranging important engineering society convention dates would be practically complete.

Another County Park System

ANOTHER New Jersey county has followed the good example set many years ago by Essex County in deciding to establish a county park system. Reference is made to Union County, south of Essex County, and including Elizabeth, Plainfield, Summit, Cranford, and other New York City suburbs. The Essex County park system has long been noted for its mountain reservations and its city and neighborhood parks. Union County has fine opportunities in the same line. It is gratifying to note the part that has been taken by engineers in promoting and securing the adoption of the Union County park scheme, as stated on p. 978 of this issue. Engineers are particularly fitted for civic work in this field, since they can readily appreciate the advantages not only of park systems but also of securing the land before it becomes occupied and costly and also because their engineering knowledge makes them particularly competent to serve as commissioners in the development and maintenance of parks.

Highway Standards Progress

THE future is bright for the duplication in the highway field of the excellent standardization work of the American Railway Engineering Association. Last week's technical program of committee work of the American Association of Highway Officials is a clear indication of highway development along proper economic lines. In the highway field as was the case with the railways in the early days, there has been a multiplicity of ideas as to methods, tests and limits in specifications until the contractor or material man who attempts to do an interstate business finds so many varying requirements that he is utterly bewildered. Under such conditions, of course, costs mount rapidly. The association is directing its efforts to bring about some degree of standardization. Looking to the elimination of state-line restrictions the committee on tests has divided the country into nine districts in which geological conditions make materials similar and like limits in specification therefore obvious. Committees have already started on the preliminary work of gathering data of existing practice. The report on standards has brought together a most commendable compilation of the various state standards of such things as slopes, drainage, guard rails, width, loading, thickness, curbing, crown, super-elevation and maximum and ruling grades. Many of these items are susceptible of engineering analysis and if the projected manual of recommended practice were in existence it would soon become standard practice throughout the country.

The Warren Paving Patents

THE expiration last year of the basic patent (No. 727,505) for the Bitulithic type of pavement controlled by Warren Bros. Co., of Boston, has left many highway engineers in doubt as to the status of the patents under which the company is now operating. In an effort to clarify the situation *Engineering News-Record* presents in this issue a summary of the several patents involved, as disclosed by an examination of the so-called Wallace patents, and an inquiry into the prior art. The aim has been to present the facts in the case, as disclosed by official documents. The publication of this matter comes at a time when the validity of the Wallace patents is the subject of a suit now pending in the federal courts in California.

The Federal Budget

THE first step toward a reformation of government business methods has been taken. For the first time a federal budget has been submitted to Congress with a fair chance of being observed in the appropriation bill. As noted in the news columns, the amount submitted is as great as that appropriated last year, which on its face does not indicate any great reform, but the reform will come in the cutting down of next year's deficiency appropriations. If General Dawes' system succeeds in persuading Congress that the Executive has really named its minimum necessities and in convincing the executive departments that they must not spend what they do not have, it will have gone a long way toward that necessary reduction of government expense which must precede the response to the loud demand for the cutting down of taxes.

War's Share

THE BUDGET discloses what we all have known but which deserves reiteration just now—that past wars and present military precautions consume by far the largest share of our annual government expenditures.—For example, in the budget for the fiscal year ending

in June, 1923, the estimate for the war and the navy departments, for pensions, the U. S. Veterans Bureau and for sinking fund and interest on the public bedt, incurred largely for financing the last war, is $2,767,000,000 out of a total of $3,505,000,000. In other words, less than $800,000,000 suffices for the administrative and constructive work of the government; just another reason for widespread support for the disarmament program which the President has fathered.

The Joint Committee Discussion

LAST week's first public discussion of the Joint Committee's new tentative specifications for concrete and reinforced concrete made perfectly clear that many clauses in that document were in the nature of trial balloons sent up to test the air, that is the temper of the designers and builders of concrete. This feature of the specifications has been emphasized and re-emphasized, but it will stand reiteration. To many there is in printers' ink some virtue which confers infallibility. In spite of alternate clauses, footnote hedgings and prefatory protestations of doubt, the specifications are being accepted by some as the final word of a group well fitted to pronounce on the present state of the art and science of making and using concrete. It happens, too, that those most disposed to accept unquestioningly the provisions of the specifications are the ones least fitted to decide for themselves any mooted question. They read the word "tentative" at the head of the document but they argue to themselves that so distinguished a body of experts would not set their names to it were they not pretty sure that what it said was correct. That this is so is not the fault of the committee. Taken all in all the procedure adopted seems to be the only one to pursue. For many years we have been saying that the knowledge of concrete is changing and this is as true today as it was ten years ago. Not yet have we arrived at the time when any group, however representative and however expert, can set down incontrovertible dicta regarding concrete. The best that they can do is to work out in as substantial agreement as possible a code which exemplifies current knowledge and submit that code to the discussion of the whole profession. This the committee has done and before the year allotted to discussion has elapsed it will be in possession of many facts and opinions which will enable it much more nearly to approach a consensus of available knowledge and opinion than it has in its preliminary report. But no one must be allowed to forget that the report now before us is not final.

One Use for an Engineer

FROM the trend of the discussion both on and off the floor at the Joint Committee meeting, it seems that the clause most likely to be removed from the final specifications is the alternate provision placing the responsibility for the strength of the concrete on the contractor. Its obvious faults were clearly pointed out, and the arguments were so conclusive that it seems hardly possible that the committee will allow it to remain. At the same time the probable intent of the clause was consistently overlooked by its opponents. As Professor Abrams well said it is not entirely opposed to the interest of the contractor. It has been common enough for a contractor on any given job to say that he knew how to make good concrete and that if he were allowed to select his own sand and stone and decide on his own method of mixing and placing, free from the annoyance of the theories of the ultra-scientific engineer, he could produce a concrete of more than the acceptable strength and durability. The debated clause would give the contractor just that privilege. The chorus of objection that has gone up from the contracting fraternity against the clause shows that he does not really want it if at the same time he must accept the responsibility that goes with it. Which should show some of the more violent of the contractors that the engineer is some use after all.

Tax-Exempt Securities

AS IS NOT uncommon the President's message to Congress last week was a business address. The refunding of our foreign loans, the safeguarding of our merchant marine, the tariff, the farmers' plight, railroad rates, reclamation and an industrial court were touched on. We do not propose to discuss these recommendations, but rather to call attention to a recommendation buried near the end of the address which ranks with, or above, any of the recommendations in importance. We refer to the advisability of prohibiting by constitutional amendment the issue of tax-exempt securities. On this subject popular opinion has crystallized rapidly. Even he who runs can appreciate that the sources of prospective industrial capital have been diverted to tax-exempt public securities. What has been to the detriment of private business has tempted development by public authorities. We constantly need enlargement of public-service facilities, but the favoring of them should not be at the expense of private enterprises which, as the President well said, are the "very activities which make our wealth."

Poor Care of Paving Mixers

MIXER manufacturers report that only one of five paving mixers returned at the season's end to be overhauled shows that it has had reasonable care in operation and maintenance. These figures tally closely with field observations of numerous paving mixers in operation. Besides indicating poor business sense, these conditions speak poorly for the technical proficiency of highway contractors. Obviously if contracting is to maintain successfully its claim to expert skill in constructing, it should be made clear by the workmanlike manner in which contractors operate and maintain expensive machines for construction. The mechanism of a paving mixer is not only extensive but it is correlated so that the various operations will co-ordinate almost perfectly. It needs but a moment's thought to realize that a machine process which by half a score of operations, takes a container of raw materials from a car or truck and places them as mixed concrete on the subgrade inside of two minutes and often in a minute and half, with one minute of the time consumed in mixing, requires precise operation and has to be tuned up to high pitch of mechanical efficiency. Certainly no mixer can be in fit condition for precise operation if it is so plastered with hardened concrete, as manufacturers in some instances report, that it has taken two men a week to clean the mechanism so that it could be overhauled. By the same token no contractor, who allows such a state of affairs to occur with expensive equipment, can justify to highway engineers a claim that he needs higher prices and more liberal specifications.

New Highway Research Data

ANOTHER addition to the growing volume of highway research data has just been made by the U. S. Bureau of Public Roads in announcing results of the effect of impact on pavement slabs as developed by tests conducted at the Arlington experimental farm. It is clear that the bureau is following a conservative policy in the matter of drawing conclusions from results thus far obtained for the information—summarized last week—is offered with carefully specified qualifications, indicating that the complete story still remains to be told and warning against injudicious use of the results thus far secured. Nevertheless, the test results are of value even though they must be considered mainly as the foundation for later investigations. The bureau's principal highway research program, it will be recalled, involved three elements involved in the rational design of paving surfaces: First, the character and magnitude of loads to be supported; second, the resistance of various kinds of pavement under varied conditions of loading and support; and, third, the condition of support offered by the subgrade.

The preliminary results on the effect of motor-truck impact have already been reported; in last week's issue information on the second element of the problem was given; and announcement of the results of the subgrade studies is promised for the future. So definite a relation has each of these three elements to the ultimate solution that all must be further studied and correlated before workable data for design purposes may be safely used. With the recent enactment of the Federal-Aid Highway Bill, however, assurance is given of funds for continuing the federal government's research program and the publication of results.

Viewing the Bridge as a Whole

FOR ordinary purposes of engineering planning it is sufficient to have a dissected view of the structure that is to be planned, and deal with the several parts more or less as though they existed alone. Engineering of higher character requires more than this: it rests on a comprehensive view of the structure as a unit, a view in which the interrelation and co-operation of the parts are primarily regarded as an expression of the functioning of the whole. Such a view of the steel bridge may be derived from the admirable Swiss tests on the Suldbach bridge, reported on p. 982, and for this reason they make a basic contribution to bridge and structural knowledge. They tell us much in detail about the behavior of elements of the steel bridge, but more about the behavior of the whole; and by easy extension they apply in little less than full scope to other types of steel structure.

Hitherto engineering conceptions of the bridge as a unit structure—in so far as they existed at all—have been largely based on abstract reasoning, and therefore have lacked the force of conviction that arises from practical demonstration. It has more or less always been understood that structural units which are connected (as is usually the case) by substantially rigid joints form in the aggregate a composite elastic body, which resists load attack as a whole and which is distorted and stressed throughout by every applied force. But this has been understood only in an academic way; realizing the conditions concretely from a practical demonstration is quite another thing. Only such concrete realization can give the engineer full mastery of his structures.

The pioneer engineers understood their structures as integral units, while they had but hazy knowledge of the action of its component parts. Many of their achievements still excite wonder and admiration. The modern engineer, with very precise knowledge of the action of bridge elements, has much less of the unit view, and his work commonly bears the stamp of routine, or at least of conventional solution. This is said with due recognition of the fact that modern problems are themselves mostly of routine character, and that there is not much room for originality in exploring the possibilities in the way of solution. Any comparison of pioneer and modern work, we believe, is likely to show a broader grasp of the structure or problem as a whole (though with serious faults in many a detail) than corresponding modern work. We need this broader comprehension of the bridge as well as of other works; the Suldbach tests help to give it.

From the standpoint of the American engineer, used to large-scale demonstration, it may seem inconsistent to ground so pretentious a claim upon tests made on a small, insignificant bridge. Moreover, we are bound to be surprised at finding our Swiss colleagues willing to spend so much patient and careful labor on a 63-ft. span. The results will not have the same weight as though the work had been done on a bridge four or five times as large. Yet there does not appear to be anything in the scale of the structure or its parts that would make the conclusions inapplicable to bridges of much greater magnitude. The engineer who is inclined to discount the value of the results will find it worth while, we believe, to formulate in definite terms his doubts concerning the general validity of the data before he rejects any part of them. With respect to open-top bridges certainly the general picture of distortion and stress distribution derived from this small bridge should hold with great accuracy for any other. And the engineer's judgment should enable him to transfer quite readily to the case of a bridge with top-chord bracing, and apply the experimental conclusions in suitably modified form.

Detail results, such as those bearing on continuity of the floor, transfer of chord stress through the stringers, and participation of the bottom laterals in the chord action, appear in every case to be available for general application to bridge structures of all sizes and types. It is hardly possible to ignore the transfer of moment at stringer end—connections, the twisting and lateral bending of floorbeams, the excess stress in the wind diagonals, and the extra stresses brought on the connections of all these parts, merely because the bridge was small. Doubtless the very much deeper and stiffer floor construction of American railroad bridges will alter the numerical ratio of some of these effects, but there is no present reason for believing that any of them are reduced to a negligible point. Until proof is given to this effect it will be a safe conclusion to assume that identical actions take place in our bridge floors as found over there.

When the great amount and comprehensive character of the data secured by the Suldbach tests is considered, the practical possibilities of well planned research in the field of the civil engineer's structures become apparent. There is hardly a part of the civil engineering field that does not offer corresponding opportunities for fruitful investigation.

Missouri River Banks Protected by Tree Retard

Illinois Central R.R. Work—Current Retards of Whole Trees Tied to Concrete Piles Cause Protective Silting

RAPID bank erosion of the Missouri River north of Omaha, Neb., with threatened injury to the line of the Illinois Central R.R., made it necessary for the railway company to take steps early in 1921 for the protection of its property. Checking the current along the bank in order to stop erosion and to promote silting was the method of protection adopted. For this purpose spur dikes or current retards of a patented type were placed extending from the bank. These consist of whole trees laid as floating mattresses attached by cables to concrete anchor piles.

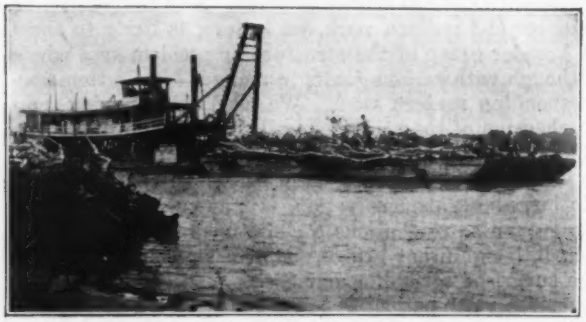

FIG. 1. PLANT FOR BUILDING CURRENT RETARDS

This protective work was applied at two points, as shown in Fig. 4: (1) For about 750 ft. on the west bank directly north of the Council Bluffs bridge, where the river threatened to cut a channel under the bridge approach; (2) on a stretch of about two miles of the east bank, at a bend known as the Narrows, this work beginning about three miles above the bridge. The location and spacing of the retards are shown on the plan. With the construction of the first retard the silting above the bend was so rapid that the next two proposed retards were omitted. Closer spacing was required where the current struck the bank below the bend. These retards vary in length from 80 to 170 ft. In the construction of a retard, Fig. 2, the first step was to sink from two to four concrete piles of the Bignell type, having bottom and side outlets for water jets, as described in *Engineering News-Record*, June 23, 1921, p. 1078. The piles were 14 x 14 in. in section, 20 ft. long, weighing about 5,000 lb., and were shipped on barges from Omaha. They have a minimum penetration of 60 ft. below normal water level, the deepest penetration in this case being 96 ft. Thus the pile heads are from 30 to 70 ft. below the river bed, the piles serving only as anchors for the 1-in. and 1½-in. cables which hold the floating retard in place about 100 ft. below the anchorage. Each pile has from six to ten cables run through holes near the heads. The piles are spaced 37½ ft. c. to c., the first pile 20 ft. from shore and the outer pile in 10 to 30 ft. of water.

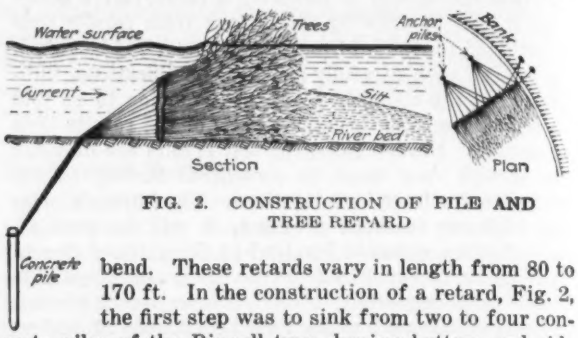

FIG. 2. CONSTRUCTION OF PILE AND TREE RETARD

Trees 40 to 90 ft. high, with 10- to 36-in. butts, were cut along the river bank and loaded on barges to be towed to the site by a steamboat. With the barge moored in position, the butts of a group of 15 to 25 trees were stapled to a ¾-in. cable, such groups then attached to the anchor cables and hauled off the barge.

A sternwheel steamboat about 112 ft. long was used

FIG. 3. ANCHORED TREES STOP CUTTING OF BANK AT ILLINOIS CENTRAL R.R. BRIDGE

for this work, having a 35-ft. A-frame or derrick at the bow to handle the piles (see Fig. 1). This boat with a crew of 14 men could sink ten piles to a 90-ft. depth in a ten-hour working day. In connection with the boat there was a gang of 10 to 20 men cutting trees and hauling them onto the barge; also a gang of 8 men with a hoist building the trees into rafts on one barge while the steamboat was towing a second barge. Two steamboats were used on part of the work.

Silting above the retards is slow, particularly during the first twelve months. Below the retard the silting is rapid, varying with the amount of sand which the river is carrying at the time. In a week after completion of a retard there was often a fill averaging 10 ft. deep, 100 ft. wide and 800 ft. long (see Fig. 5). A retard 150 ft. long could be built in about two weeks.

Difficulties were encountered in some parts of the work. Retard No. 1 (see plan, Fig. 4) was intended to close the chute channel beginning above the Pigeon drainage ditch and extending along the east bank, since this chute would ultimately deflect the river towards the east bank. Ordinarily this chute carries a large part of the main flow of the river, but in the spring of 1921 there was not as much water as usual, so that retard No. 6 was the first to be built. In the meantime the river rose to its usual spring stage and the chute scoured out to a depth of 10 to 35 ft. Retard No. 1 was then built as quickly as possible and within a few days after its completion the silting had shut off the water. Quick work had then to be done to complete Nos. 4 and 5 before the chute ran dry.

As soon as these last two retards were built the silting below them proceeded rapidly, so that great efforts were required to complete Nos. 7 to 10 before the sand bars below grew to such proportions as to exclude floating equipment. When these had been completed the railway engineers ordered work transferred to retards Nos. 11 to 13, for the protection of the west end of the bridge. These were 75 to 150 ft. long and the work was accomplished easily, as the main channel of the river was flowing against the bank. After the bridge had been thus protected, retards Nos. 14 and 15 were built on the east bank. Fig. 3 shows one of the retards placed to stop the cutting at the bridge, one of the girders of which is indicated by the dark line at the left.

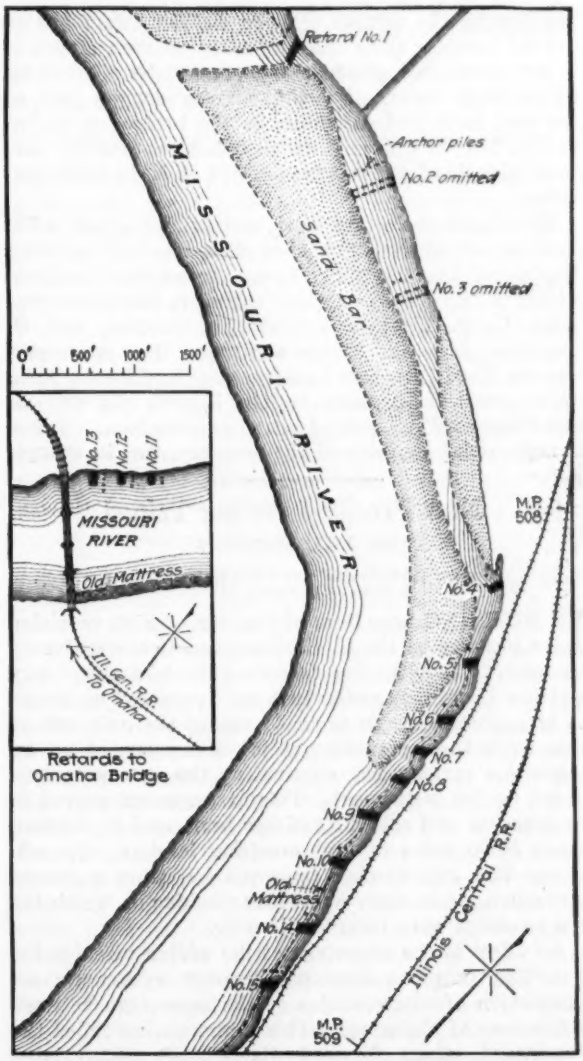

FIG. 4. CURRENT RETARDS ON MISSOURI RIVER

No longitudinal protection is placed between the outer ends of the retards, but the silting extends far beyond them, sometimes forming a bar 800 or 1,000 ft. wide (Fig. 5). In future high water stages, part of the

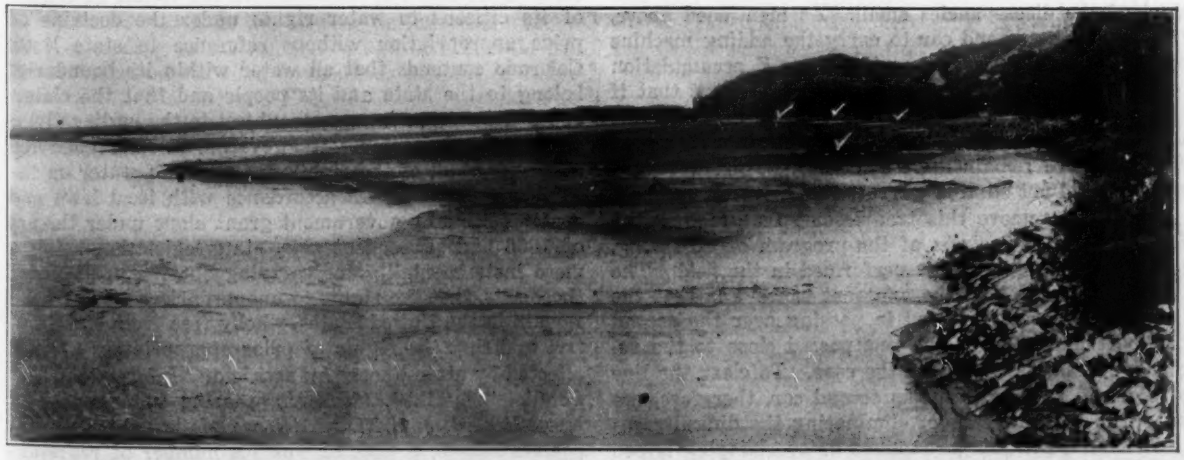

FIG. 5. EXTENSIVE SILTING CAUSED BY CURRENT RETARDS. FOUR RETARDS INDICATED BY WHITE CHECK MARKS

bar beyond the retards may be washed away, but as the fill between them was deposited at such stages it is not considered probable that it will be affected by future high water. An old mattress along a part of the east bank and extending to the bridge, as shown in Fig. 3, is of ordinary woven brush construction covered with hard red sandstone, but it is in poor condition.

This bank protection work, comprising about 1,500 lin.ft. of retard with 30 anchor piles, was built between May 4 and Aug. 23, 1921. It was done under the direction of F. L. Thompson, chief engineer, Illinois Central R.R.; C. C. Westfall, engineer of bridges, and C. Chandler, assistant bridge engineer. The contractor was the Woods Brothers Construction Co., Lincoln, Neb., which owns the patents on the Bignell pile and on this "Standard" system of retard construction. Wayne Pringle, chief engineer of the company, was in charge.

New Precise-Leveling Tripod

By J. D. Crichton

Junior Hydrographic and Geodetic Engineer
U. S. Coast and Geodetic Survey

In running long lines of leveling of high precision the practice of the U. S. Coast and Geodetic Survey has been to have the line follow a railroad right of way and use inspection motor cars or "speeders" as means of transportation. In order to reduce the unit cost of this work the instrument tripod was mounted on an inspection car, thereby eliminating the time necessary to set up the instrument. This arrangement proved to be practical and efficient and has been used in running about 5,000 miles of high-precision leveling. Its efficiency was still further improved by using a second inspection car to carry an adding machine on which the rod readings were recorded directly.

An offset to the advantage of the adding machine for recording purposes developed through systematic accumulation of discrepancies of the same sign between differences of elevations. This accumulation called the "backward minus forward divergence" (abbreviated $B - F$), is the sum, having regard to sign, of discrepancies between backward and forward runnings for a complete line or loop. It is the same value for the whole line as the closure error if the line were run forward through its whole length and backward to the starting point. The aim, of course, is to have the sum total of the discrepancies small. As mentioned above, the use of the second car to carry the adding machine apparently caused a systematic $B - F$ accumulation of negative sign. It was found by experiment that if the second car was ahead of the observing car during half the distance and following it the other half, the $B - F$ curve remained close to zero. This procedure however, did not eliminate errors in sections of the line.

Efforts to remove this troublesome feature took the form of a close analysis of the program of observing, together with experiments performed in the field. The results indicated that the apparent cause was that the line of sight was refracted in passing over the second car, particularly when the line passed close to the recorder's head, as was often the case. To clear the line of sight in passing over the second car, therefore, appeared to be the means of eliminating the difficulty.

On this hypothesis an inclined or overhanging tripod was devised such that the vertical line through the center of the tripod head was about 8 in. outside of the inspection car. The recorder and the adding machine were placed on the opposite side of the second car. The illustration shows the clearance to the line of sight and the appearance of the tripod as used.

About 140 miles of high-precision leveling were run with this arrangement with the second car always following, this being the most convenient relative position of the cars. The $B - F$ divergence curve crossed zero five times and reached a maximum value of eleven millimeters and a final value of eight millimeters. No systematic tendency of the $B - F$ divergence to increase appeared. The ease of manipulation of the instrument mounted on this tripod proved greater than with the old arrangement.

PRECISE-LEVELING INSTRUMENT ON TRIPOD ON RAILWAY "SPEEDER"

The small amount of work done with the overhanging tripod furnishes little evidence on which to judge its merits, but the results available at this time show promise of superiority over the centrally-mounted tripod.

To Reargue Wyoming-Colorado Water Case

The U. S. Supreme Court has ordered a rehearing of the Wyoming-Colorado water case Jan. 3, 1922. It is a case in equity brought Jan. 11, 1918, by Wyoming against Colorado to enjoin a diversion of water from the Laramie River, an unnavigable river rising in Colorado and flowing into Wyoming.

In this action, according to the November *Reclamation Record*, Wyoming seeks to uphold the claims of certain of its citizens to water rights under the doctrine of prior appropriation without reference to state lines. Colorado contends that all water within its boundaries belong to the state and its people and that the claims of its citizens are in no way subject to the earlier diversions in another state. The government intervened and asserts that all of the rights to the use of water on the arid region secured in accordance with local laws and customs come by government grant alone under the act of 1866 and subsequent acts, state legislation being a mere instrumentality for carrying out the purposes of those acts, that the rights to unappropriated water shall remain in the United States, wholly free from state control and that the rights of prior appropriators are not affected by state lines. An article on "Interstate Water Conflicts" by R. I. Meeker, appearing in *Engineering News-Record*, Jan. 27, p. 157, was followed by a symposium May 5, p. 755, to which a number of representative western engineers contributed.

The Status of the Warren Company's Pavement Patents

Since Expiration of Basic Bitulithic Patent Last Year the Wallace Patents for a "Composite Pavement" Have Been Featured — Prior Art Reviewed

WHAT is the status of the Warrenite-Bitulithic paving patents?

Judged by the inquiries which *Engineering News-Record* receives, from time to time, this question is puzzling many highway engineers, particularly in view of the fact that the basic Warren patent (No. 727,505), covering the grading of the mineral aggregate to produce "inherent stability" in the so-called Bitulithic type of construtcion, expired last year. Nevertheless, the Warren Bros. Co., with headquarters in Boston and district offices in 14 other cities, is active in the highway building field, particularly in the Southwest and on the Pacific Coast, and is now featuring a "composite pavement," under the name of Warrenite-Bitulithic, covered in patents granted to Edwin C. Wallace, in which two courses of mixed bituminous composition—a relatively thick base containing graded stone and a thin top course or seal coat of what amounts practically to a sheet asphalt surface mixture—are laid separately, *without compression*, and then compacted *simultaneously* by rolling, so as to produce what is claimed to be an "integral mass." In fact, the outstanding claims of the Wallace patents relate to the simultaneous compression of the upper and lower courses of the pavement, the effect of which, as variously described in the several patents, is to "anchor" and to "lock" the two courses together, the thin upper course rendering the pavement impervious to the elements and the lower course, being "possessed of rigidity," acting as the main body of the pavement. The details of the several Wallace patents will be set forth more fully later in this article.

The Old Warren Patent

It would seem advisable, in the interests of a fuller understanding of the status of the patents covering this type of construction, to go back to the old basic Warren patent and make note of such new developments as have occurred. Under the early patents the Warren company was continually engaged in a widespread campaign of propaganda, both by printed word and personal emissary, with the result that a large yardage of Bitulithic and Warrenite pavement has been constructed —70,386,588 sq.yd. in the 19-year period from 1901 to 1919, according to the company's figures. The old patent was the subject of a tremendous amount of litigation, but in the end the Federal Courts sustained its validity. Scores of city and state highway engineers, contractors, chemists—in fact, experts in every branch of the paving and allied industries—have testified at one time or another in cases involving the Warren patents.

The basic Warren patent under which such a large volume of highway construction was done until a year ago carried United States Patent Office No. 727,505, dated May 5, 1903. It was granted to Frederick John Warren, of Newton, Mass., whose application was filed May 16, 1901 (Serial No. 60,450), and in accordance with the law which grants a 17-year term to the life of a patent, expired May 5, 1920. While the Warren interests have taken out, or acquired, a host of other patents covering paving materials and processes in great detail, No. 727,505 was the one which covered the mineral aggregate grading commonly used in the Bitulithic type of construction and involved the widely advertised claim of "inherent stability." It was this patent which served as the foundation for building up the Warren company's business to its present large proportions, but for the purpose of this review, inasmuch as the patent has expired and may, therefore, be used without liability of suit for infringement by any one who desires to construct a pavement of this type, attention may more profitably be directed to subsequent patents which are still operative and under which the Warren company is now doing business.

Later Patent Developments

A search of the records of the United States Patent Office discloses the fact that the Warren Bros. Co. has taken great precautions in an endeavor to exclude the possibility of encroachment upon its field, for no less than 52 patents have been granted to individuals of that organization or acquired by them. While this list includes a few patents relating to asphalt and wood blocks, a waterproofing process, bituminous shell roads, and a reinforced-concrete wall, the bulk of them deal directly with equipment or construction methods, manufacturing processes or materials involved in bituminous-type pavements. Of this number, 24 patents have expired and the remaining 28 are still in force. From this imposing list four patents may be cited as the ones which have the most direct relationship to work now under the Warren specifications. All of these four were granted to Edwin C. Wallace, of East Auburn, Cal., from whom control has passed to the Warren organization. The numbers and dates of these patents follow:

Patent No.	Date Granted	Application Filed
959,976	May 31, 1910	June 28, 1909
1,115,259	Oct. 27, 1914	Nov. 23, 1910
1,183,506	May 16, 1916	March 4, 1910
1,183,507	May 16, 1916	May 21, 1910

In all of these patents the claims, in general, cover a "composite pavement" consisting of two courses, the upper one being a thin layer of bituminous material and fine mineral aggregate, and the lower layer of coarse-graded asphaltic concrete. It is essential, according to the patent claims, that the lower course be *not* consolidated prior to the application of the top course or seal coat. The two courses must be simultaneously compacted in order that the two, according to the language of the patent claim, may be "blended and bonded," and "made a compact and substantially integral mass which is densest at its top."

The claims in each of the foregoing patents are briefly summarized below:

No. 959,976.—This patent covers "improvements in composite pavements" and provides for a lower course of mixed bituminous concrete covered, before compression, with a thin layer of fine-graded bituminous topping, the two layers then being compressed simultaneously so as to bond the two layers into one and produce a compact, rigid mass, densest at the top.

No. 1,115,259.—The claims, here, are for a two-course

pavement with a relatively hard bituminous cement in the lower course and a relatively soft bituminous cement in the upper course. By the use of large mineral bodies "fissures" are produced in the lower course and into them the material of the upper course is compressed, anchoring the two courses and preventing creeping of the wearing surface.

No. 1,183,506.—Here the lower course is constructed by the penetration method, instead of the mixed method described in the other patents; otherwise the process is essentially the same as already described.

No. 1,183,507.—This covers an improved process for wearing surfaces and specifies the following construction details: A bottom course of crushed stone from 1½ to ½ in. in size with enough fine matter to regulate the voids within limits of 22 to 28 per cent and a sufficient quantity of bituminous cementing agent to coat the mineral aggregate without filling the voids. The top-course mixture consists of bituminous cement and fine mineral aggregate, passing a screen with 6 meshes to the inch. The top course is "loosely spread" upon the lower course, before the latter has been compressed and the two are then simutlaneously compressed by rolling to secure "an intimate locking of the upper and lower layers."

From the foregoing it is clear that the Wallace patents produce a pavement which is closely analogous to a very thin sheet asphalt surfacing on a close binder, the top layer being generally about ½ in. thick. It will be noted that in all of the foregoing patents one of the main features is the one providing for the interlocking of the two courses, laid originally without any compression, by rolling simultaneously.

Specifications

Based on these patents the Warren company has issued the following specifications covering an "improved method of laying wearing-surface mixtures," which are quoted from p. 53 of its booklet entitled "A Decade of Improvements in Warren Pavements":

"On the foundation prepared as hereinabove specified, shall be laid the Warrenite-Bitulithic wearing surface described below, so as to have a thickness of 2 in. after thorough compression.

"The wearing surface shall be a mixture of (1) mineral aggregate and (2) bituminous cement.

"*Mineral Aggregate:* Shall be composed of hard, crushed stone or clean, sound gravel, for the coarse material combined with sand (or a mixture of sand and screenings) for the smaller sizes. The size of the particles of the aggregate shall vary from the maximum (about one-half of the thickness of the wearing surface) to impalpable powder.

"The different sized particles of aggregate shall be combined in such proportions as to secure in the mineral aggregate density or low percentage of voids and a useful degree of inherent stability or resistance to displacement.

"If the crushed stone or gravel and sand do not contain enough finely divided particles or impalpable powder to produce a low percentage of voids in the aggregate, the deficiency shall be made up by the addition of any other suitable fine mineral matter.

"*Laying:* The mixture and ingredients thereof shall be maintained at a temperature consistent with good workmanship.

"The mixture when reaching the street shall be hot enough to allow being easily spread and raked and shall not be so hot as to injure the Bitulithic cement.

"The coarse mixture shall be placed with hot shovels or forks and shall then be spread with hot rakes. Immediately after the said mixture has been spread and before it has been compacted in any manner, it shall be covered with a mechanically mixed, rich, glossy, bituminous surfacing mixture composed of Bitulithic cement and mineral aggregate not larger than ¼ in. in diameter, except on grades where a coarser aggregate may be used. This mixture shall be spread at the rate of 30 to 50 lb. per square yard and, depending on the sizes of the aggregate, shall contain from 8 to 12 per cent of bitumen soluble in carbon bisulphide.

"*Rolling:* Immediately after spreading the mixtures as described above, the pavement shall be thoroughly compressed by use of 10 to 12-ton, three-wheel, self-propelled rollers. The rolling shall be continued until no roller marks appear."

Advantages Claimed

In its printed literature the Warren company points out the advantages of its "improved method of laying wearing surface" mixture in the following language:

"Appreciating that, under the old flush-coat method of application of sealing coat, about 80 per cent of the aggregate, spread over the seal coat bitumen to a depth of about ¼ in., is generally ground to powder and washed, blown or swept from the pavement surface, and therefore not available for subsequent wear, we have devised a new and better method of laying the wearing surface mixture, which method not only eliminates the waste of flush-coat materials referred to, but also produces a surface more impervious to the elements than can possibly be obtained under the old flush-coat method.

"The present method consists of first spreading the wearing surface mixture in the usual manner, then, before this has been compacted in any manner, immediately spread over same, a rich bituminous mixture of fine aggregate which is then immediately rolled thoroughly, thus forcing a portion of this fine, rich mixture into the spaces between the uppermost stones of the wearing surface mixture, and also compresses the two mixtures together, so as to produce one compact, integral mass, without any line of cleavage between the two mixtures.

"This produces a pavement surface consisting of a true bituminous concrete having the advantages of great density and inherent stability of the aggregate and also the added advantage of having the surface thoroughly protected from the elements by a thin surfacing of very rich, dense, resilient bituminous mixtures.

"On account of the above mentioned fine mixture being tied into and bonded with the coarser mixture by the rolling, it is possible to make the fine mixture much richer in bitumen than would be practicable with other forms of bituminous pavements, without causing 'shifting' or 'rolling' of the surface. This is a particularly valuable feature of the improvement, because the life of the structure as a whole is considerably lengthened by the protection given to the stone by this plastic, resealing surface."

The Prior Art

It is now in order to inquire into the prior art—that is, what materials or processes similar to those covered by Wallace were in use or patented prior to the filing of the Wallace applications on June 28, 1909, and thereafter.

On May 18, 1880, the United States Patent Office granted to Davis W. Bailey, of Chelsea, Mass., patent No. 9,207 (reissued) for "composite or concrete pavements"—the term "concrete," in this instance, covers a bituminous, not a portland cement, concrete form of construction. The Bailey patent specifies a three-course pavement, the lower layer of which, however, is essentially a broken stone foundation which need not be considered in a comparison with the Wallace patents. Upon the foundation course is deposited, according to the description in the Bailey patent, a 2½-in. layer of large stones to which a bituminous composition is subsequently applied by pouring, and upon this layer is deposited a 1½-in. layer of a fine-graded asphaltic mixture. The important steps in the process are thus stated:

"Upon this foundation thus acquired I deposit a second

stratum, about 2½ in. thick, of stones of a more uniform size and of from ½ to 2½ in. in diameter, subsequently pouring upon them a quantity of a heated mixture composed of coal tar, asphalt, and oil of pitch, the latter of which is a refuse residuum in the production of resin. Upon this last mentioned deposit of stones smeared and cemented together, as explained, I dump and distribute a layer, about 1½ in. deep, of concrete composed of fine gravel, coarse sand and sifted coal ashes, mixed with a composition of asphalt, coal tar and oil of pitch. . . .

"After having solidified and condensed into a smooth surface the two stratums of stones and composition by the employment of a heavy roller, I apply to such surface a combination of dry fine sand. . . ."

It will be seen that the patent does not expressly state that there shall be only one rolling, but the inference may well be drawn that there is no compression prior to placing the top-course material. Nevertheless, that there may be no misunderstanding, it should be pointed out that the details of applying compression do not seem to be of the essence of the Bailey patent.

Apparently the chief difference between the top courses of the Bailey and of the Wallace patents lies in the fact that Bailey specifies for the mineral aggregate "fine gravel, coarse sand and sifted coal ashes," while Wallace provides for a "mixture produced by commingling sand or crushed screenings (comminuted stone) or both with sufficient bituminous or asphalt cement to form a homogeneous mass." Bailey's mineral aggregate grading for the top course appears, therefore, to be coarser than that of Wallace.

Two Other Patents

Further inquiry into the prior art discloses two other patents which may be cited. The first, No. 797,404, dated Aug. 15, 1905, granted to George W. Crichfield, of Jersey City, N. J., and William T. S. Crichfield, of New York, N. Y., was for a "monolithic" pavement formed of asphalt blocks; the application was filed Dec. 20, 1904. The second, No. 958,063, dated May 17, 1910, was granted to Joseph Hay Amies, of Philadelphia, for a bituminous concrete surface pressed into a concrete base; the Amies application was filed Feb. 20, 1909.

The Crichfield patent covers a pavement consisting of individual blocks, each made up of two layers of bituminous material of different composition "permanently or inseparably joined together by pressure when in hot, plastic condition." The essential feature of the Crichfield block is a relatively elastic upper stratum or wearing surface and a relatively rigid lower stratum or base. It is true that an essential difference between the Crichfield and the Wallace pavements is that the one is composed of separately molded blocks, while the other is a continuous, integral surface. But an examination of the two patents indicates a great similarity in the general principle of joining the two layers. "Each of these blocks," says Chrichfield, "comprises a base or binder of firm, rigid composition and a wearing surface of a high degree of elasticity, thoroughly and inseparably joined to the base so as to form of the two layers a solid single block." The base course consists of a mixture of hard stone, graded from a 1-in. size down to an impalpable powder, and pure bitumen. The top course consists of a graded sand aggregate and asphaltic cement.

In forming the blocks the two compositions above noted, constituting, respectively, the base and the wearing surface of the pavement, are placed in separate molds, the molds are then superimposed so that the two compositions, in plastic form, lie one above the other. The compositions are then "subjected to extreme pressure tending to force the two layers together," causing them "to adhere firmly and inseparably, forming a solid block." The *form* of applying the pressure obviously differs from that of Wallace, but the result aimed at in each case is a thorough union between the upper and the lower layers of material.

In the Amies patent a pavement is produced by pressing an asphaltic stone mixture into a soft concrete base before the concrete has attained its initial set. In describing his process Amies says:

"This composition, . . . I now spread over the portland cement concrete which I have just laid and before the initial set of the concrete aforesaid can begin, I roll or otherwise compress the bituminous composition, . . . into the soft concrete. I continue this compressing until the bituminous composition is well pressed into the concrete . . . and comes almost to a level with the face thereof."

English Road "Double-Sealed"

Finally, there needs to be quoted a portion of an article entitled 'Homogeneous Double-Sealed Road Construction," by Frank Latham, Member, Institution of Civil Engineers (London), and borough surveyor of Penzance, which appeared in *Engineering News*, June 17, 1909, p. 675 (condensed from the "Surveyor," London, April 23, 1909). It describes a form of two-course bituminous road construction, developed in 1902, as follows:

"I, therefore, followed up my earlier practice of grouting in the foundation with the preparation of tar compound and upon this sealed foundation, as it now became, I laid 4 in. of fine tar concrete made from the screenings from the stone breaker. *While this layer of tar concrete was quite loose*, it was sprinkled with lias lime and the clean machine-broken stone, broken to 2½-in. gage, was spread over to a thickness of 3½ to 4 in. and rolled with a 10-ton steam roller. The rolling was conducted quickly at first so as to arrange the layers, and when the road was fairly well formed fine tar concrete was lightly thrown over the surface and brushed into the voids which remained, the whole being then rolled to completion without water. . . Rolling has been found to be reduced by the adoption of this system. The first, or foundation, seal renders the superincumbent stratum of tar concrete sufficiently mobile to work and squeeze up into the interstices of the macadam stone, hence the layers are arranged; and on completion the whole structure, from the tar blinding (*sic*) of surface voids to (and into) the foundation is rendered homogeneous and free from any dust-producing substances. A road so made is quite waterproof and motor wheels cannot force up the dust from under the macadam coating."

It is apparent that the object here intended is different from that sought in the Wallace patents, but the idea of intimate incorporation of two layers by simultaneous rolling of both is here recognized.

Conclusion

To highway engineers the chief point of interest in the patent situation reviewed in this article lies in the advantages, if any, in improved road construction actually secured by the simultaneous compacting of the layers of material forming a two-course pavement. The general principle of a seal coat, of course, was recognized long before the filing of the Wallace claim in 1909. The present inquiry, therefore, suggests two questions for the consideration of highway engineers:

Is the single-rolled pavement of the general type cov-

ered by the Wallace patents superior to one double-rolled or otherwise sealed?

If it is superior, have highway engineers, in their practice prior to 1909, actually built pavements in which the principle of the simultaneous compression of two layers of material was employed?

No matter what the answers to these questions may be, the inquiry in this article lays before engineers the salient facts concerning the claims of the patents under which the so-called Warrenite-Bitulithic pavements are being laid. There is now before the U. S. District Court in California a suit for infringement of the Wallace paving patents brought by Warren Bros. Co. and involving Thompson Bros., contractors and Fresno County. At this writing no decision has been rendered.

Fire Tests of New Post Cap for Mill Construction

Timber Columns Fitted With Reinforced-Concrete Cap Resist Fire Twice as Long as Columns With Standard Steel Cap

BY GEORGE B. MULDAUR
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IN THE elaborate fire tests of bare and protected building columns summarized by R. E. Wilson in *Engineering News-Record* of July 21 and 28, pp. 106 and 145, it was found that timber columns stand up under severe fire exposure longer than do unprotected metal columns. However, in all cases the action of the column cap accelerated the failure of the wooden column.

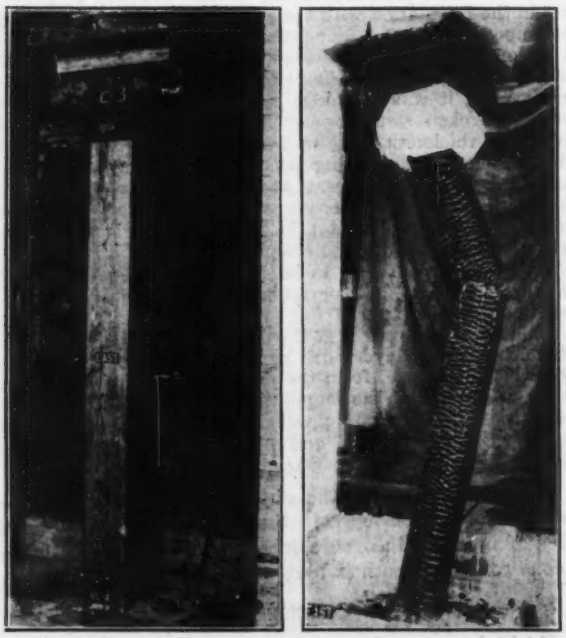

FIG. 1 AND 2. TIMBER POST (12 x 12) WITH CONCRETE CAP, BEFORE AND AFTER FIRE TEST

(Under a constant load of 59 tons, about 900 lb. per sq.in., this column stood up for 1 hr. 18 min. in the fire of the test furnace. Similar columns with steel cap failed in half that time.

With either cast-iron or steel-plate post caps such as are commonly used in slow-burning mill-construction buildings, Mr. Wilson reported "the full fire resistance of the column itself is not developed" because failure

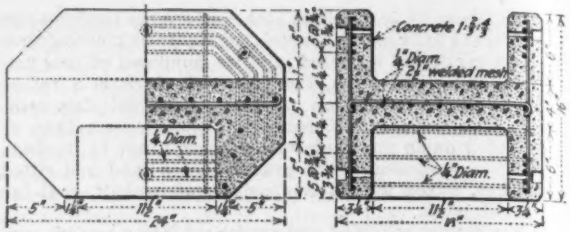

FIG. 3. INGBERG CONCRETE COLUMN CAP

occurs in the metal cap through excessive heating, crushing and brooming of the fibers, followed by slipping or failure of the cap.

With a better form of column cap, it appeared, timber construction would show even greater superiority in fire resistance to unprotected steel or cast iron framing. S. H. Ingberg, of the Bureau of Standards, subsequently designed a reinforced-concrete post cap, and at the initiative of the National Lumber Manufacturers' Association a series of fire tests of posts fitted with the new cap has been carried out by the Underwriters' Laboratories, Chicago. The results justified the expectations. The concrete post cap proved itself able to develop the full strength of the timber column, and thus to double the length of fire resistance of timber mill construction. It should be added here that Mr. Ingberg has patented his form of cap and has assigned the patent to the public.

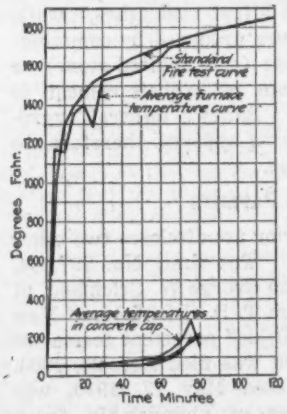

FIG. 4. HEAT INSULATING EFFECT OF CONCRETE CAP

From the previous tests it had been found that 12 x 12 timber posts failed in the high-temperature fire of the test furnace after 35 to 50 min. Check tests of posts of smaller section with steel caps made in connection with the new series tests gave similar results (four tests showed failure after 25, 45, 38, and 42 min.). With concrete caps, on the other hand, six 12 x 12 in. columns stood up for 84, 78, 108, 98, 94½, and 112 min., respectively. In no case did the cap fail or cause premature failure of the column; all the columns carried their load until the body was sufficiently weakened by the burning to fail, whereas in every test with steel caps failure occurred in the cap, as previously mentioned. The effect of the concrete cap is reflected in the readings of thermocouples embedded in the interior of the cap, recording the temperature at the middle of the end face of the post where seated in the cap. With steel caps the temperature at this point rose to 685 deg. F. during the tests, while with the concrete caps the maximum temperature reached was 195 deg. F. (see the temperature curves Fig. 4).

The tests were made in the special column-test furnace of the Underwriters' Laboratories, used also in the prior tests, as described in Mr. Wilson's article. Its interior, or combustion chamber is 7 x 7 ft. in horizontal dimensions by 12 ft. high. A hydraulic jack above the furnace is capable of applying loads up to 545,000 lb. to a member contained in the furnace. The four tests with

steel column caps were made on short posts, about 24 in. long. The concrete caps were tested on a similar short post in one test and on full-length 12 x 12 posts, 10 ft. 10 in. long, in six tests. The result obtained with the short posts is not included in the figures given above for the resistance periods with concrete caps, but as it was greater than any of the others, 124 min., its omission is on the safe side.

In one of the tests the lateral thrust developed by the column at the moment of failure resulted in cracking and breaking the concrete cap. This was not a primary failure of the cap, however, nor did it produce or contribute to the failure of the column. The caps carried no girder loads in the tests, as they would actually.

It should be borne in mind that any conclusions drawn from the test will be valid only for reinforced-concrete caps made in strict conformity with the specifications used in making the caps for these tests. The special mixture of concrete and the design of the reinforcement are factors to be considered.

Studies in the Life of Equipment

By Edwin Kurtz
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THE term "life" when used to denote the length of the useful period of existence of a unit of property has indeed had many interpretations. It is apparent at once that when the life of a given unit is being referred to, little difference of opinion should exist, for the life of a given individual unit is generally fixed.

It is when the term "life" is applied to a group of similar units, of to a given type of equipment that differences of opinion arise. To illustrate, take the life experience of poles tabulated in column 1 of Table I. The data there show how many poles are removed each year, assuming that all were put in service at age zero.

The Mode.—Some will contend that the useful life of the pole life there summarized is the time between zero age and that age at which most replacements occur. Referring to the table, the percentage of poles replaced is greater in the tenth year. This age is often called the most probable after-life time. Its statistical name is the "mode."

The Median.—Others are of the opinion that the period between zero age and the time when only one-half of the units are in service is the life of such a group of units. It represents the number of years that a unit has an even chance of continuing in service. This would also be 10 years for the data in column 1. The technical name for this function is *Vie Probable*, and its statistical name is "the median."

Curtate Expectancy.—It is obvious that the mode and the median cannot be of much value nor possess much significance as far as the whole group is concerned, because no account is taken of the units as a whole. The mode merely concerns itself with the year during which replacements are a maximum and pays no regard to the general distribution during the other years. The median likewise is determined wholly by the 50 per cent point on the mortality curve and also fails to take into account the distribution before and after that time. The "life expectancy" is a much more accurate means of representing the life of a given type of unit. By this term is meant the average number of years, which units of a given age will survive.

To evaluate this quantity the data in column 1 are sufficient. Let the percentages represent units so that column 1 summarizes the life of 100 units. Then, to determine the average after-life time find the sum of the products of age multiplied by the number of units removed during that year. This sum represents the total unit-years lived by the 100 units.

The average number of years each unit can therefore be expected to live is this sum divided by 100. For the data in column 1 the sum of all the products is 993.1 and the expectancy at age zero is 9.931 years.

Complete Expectancy.—The curtate expectancy, however, takes no account of the time lived by each unit in the year of replacement. If the removals are uniform during the year each unit will live one-half year additional to the expectancy obtained above, making the complete expectancy 10.431 years. The complete expectancy therefore differs only in that it is greater than the curtate by one-half year.

TABLE I—PER CENT OF POLES REMOVED EACH YEAR

Age (Years)	Column I	Column II	Column III
0	0.1	0.5	0 0
1	3.3	1.7	1.0
2	2.2	4.2	3.0
3	2.6	5.6	0 4
4	6.3	6.8	2.1
5	1.4	7.4	3.5
6	4.1	7.5	9.8
7	9.0	7.8	7.7
8	9.3	8.4	15.2
9	5.3	8.0	9.1
10	15.0	8.3	2.2
11	6.7	6.2	6.8
12	9.8	5.8	9.2
13	10.4	5.5	3.5
14	0.9	3.9	5.9
15	0.3	3.5	4.8
16	2.4	3.0	5.1
17	6.0	2.8	1.9
18	0.8	1.9	0.4
19	0.0	0.7	1.3
20	1.6	0.3	5.5
21	0.7	0.14	1.6
22	0.8	0.04	....
23	1.0	0.02	....
24	....	....	....
	100	100	100

Table I, column 1 summarizes the life experience of 309 poles as found by the Milwaukee Electric Railway and Light Co. The poles were set in dirt. Replacements were due to butrot, bad condition, accidents, too short, and civic improvements. (Data compiled March, 1917.)

Column 2 summarizes the experience of 1,372 wooden poles of the Electric Company of Missouri for the years 1910-1915 inclusive. Of these 1,372 poles, 42 per cent were removed because of butrot, 31.2 per cent because they were too short, 0.8 per cent because they were not heavy enough, 0.6 per cent because of accidents, and 25.4 per cent because of street or civic improvements.

Column 3 summarizes the experience of 248,707 wooden poles as found by *Geh. Ober-postrat Christiani*, Berlin, and published in the *Archiv Fur Post* and *Telegraphie* Nr. 16, August, 1905. The statistics go back for the North-German and even the Prussian telegraph systems to 1852. Poles were treated as follows: Copper sulphate, 89.9 per cent; zinc chloride, 0.4 per cent; dead oil of coal tar, 3.0 per cent; corrosive sublimate, 5.5 per cent.

TABLE II—LIFE STATISTICS ON TELEPHONE POLES

	Column I	Column II	Column III
Mode	10	8	8
Median	10	9.0	10
Curtate expectancy	9.93	8.8	10.5
Complete expectancy	10.43	9.3	11.0

The several means described above of defining average life are tabulated in Table II.

Monolithic Concrete Grain Elevator Poured In Two Weeks

580 Special Steel Moving-Form Jacks Fabricated—100 Men Kept Busy Jacking—Concrete Material Handling Unique—Capacity 2,000,000 Bushels

IN THE construction of the New York State Barge Canal grain elevator on Gowanus Canal, New York City, the contractor poured the storage bins, which are 94 ft. 8 in. high and cover a ground area 408 ft. in length and 69 ft. 4 in. in width, out to out of bin walls, in thirteen days of two shifts each. Pouring on the bins began Sept. 27 and on Oct. 9 they had been poured to their full height. That part of the structure upon which the moving-form method of construction was employed, extends from the top of the bottom slab of the bin to the bottom of the slab overlying the bin, and was poured as a monolith, an average force of 300 men being employed, one-third of whom were divided into three gangs that did nothing but jack up the sliding forms. The elevator is a terminal elevator built by the Fegles Construction Co., Minneapolis, for the New York State Barge Canal, and has a storage capacity in its 54 tanks, its 34 inner spaces and its 37 outer spaces or quarter bins, of about 2,000,000 bushels.

The circular storage bins are 20 ft. in diameter, set on 24-ft. centers, are 95 ft. high and are capable of storing 25,000 bu. each. The inner spaces have capacities of 16,000 bu. each, and the outer spaces of 4,000 bu. each. There are five main elevating legs of 30,000 bu. capacity, each, three marine legs of 25,000 bu. capacity, two of which legs are being put in now, the third reserved for future installation. The elevator will also have two marine tower lofters of 35,000 bu. capacity, three gallery lofters of 35,000 bu. capacity and one dryer leg of 15,000 bu. capacity.

The foundation underlying the elevator was put in by the Raymond Concrete Pile Co., New York City. It consists of a 3½-ft. reinforced-concrete mat resting upon wooden piles driven at an average centering of 2 ft., with pile clusters being driven beneath columns. Fig. 2 shows the position of piles, columns, mat reinforcement and the details of the foundation underlying the elevator columns.

The bins are 8 in. in thickness made of a 1:1.6:3.2 concrete mixture. Concrete in the columns, the mat and the slab is of a 1:2:4 mix. The reinforcement in the body of the bins is circumferentially placed flat bars on 1-ft. centers. For the first 65 ft. of height the bars are ⅜ in. x 1¼ in. For the next 15 ft. they are ⅜ in. x 1 in. and for the remainder of the distance ¼ in. x 1 in. The bin contacts are usually 2 ft. thick, though where greater strength is required they are increased to a thickness of 3 ft.

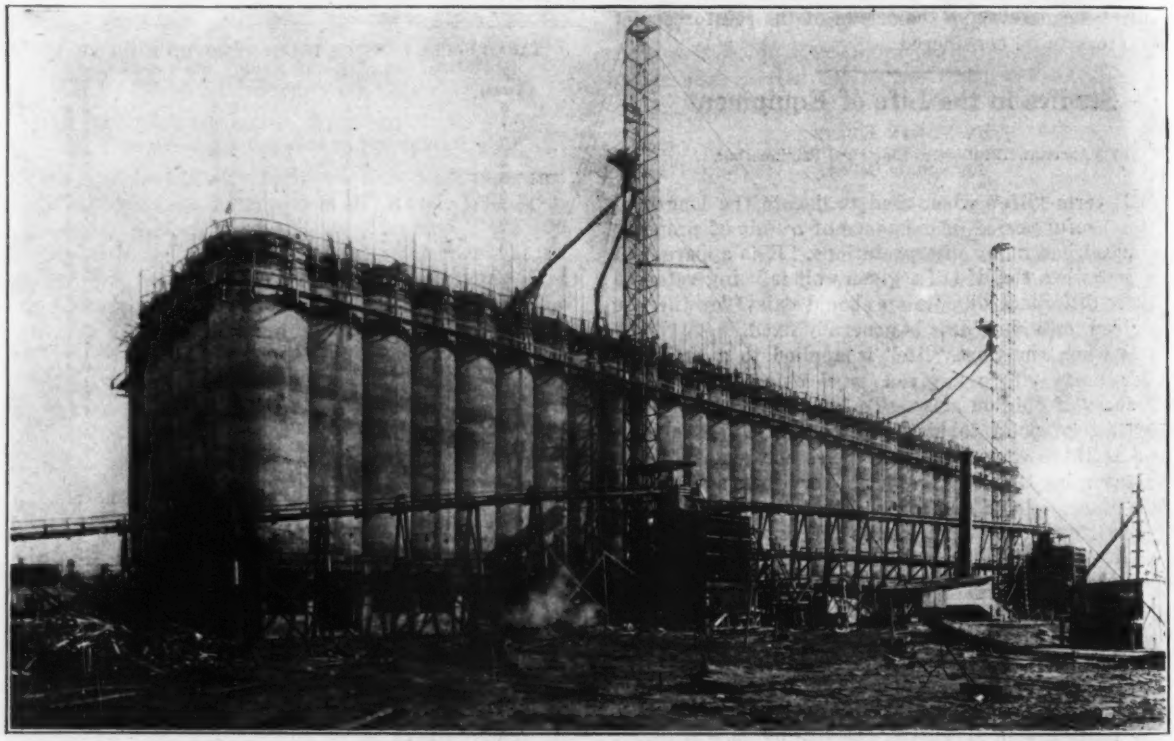


FIG. 1. THE BIN WALLS ON THE EIGHTH WORKING DAY

The contractor had fabricated for special use on this job 580 steel screw jacks to support the sliding forms. Fig. 3 shows a close-up of one of these jacks. They are made up of light channels properly stiffened and tied near the midpoints and at one end by lighter channels. Where the main channels are tied near the midpoints they are bent so that the distance between them at the top is about half that at the midpoints. Through the top channel runs the screw, which is made of hollow steel 2 in. in diameter. Between the cross channels and about 3 in. from the screw on either side run two light steel bars securely fastened to the cross channels. On

these bars a steel plate slides, to which are fastened the end of the screw pipe, as well as iron dogs which bite into the jack bars as the forms are elevated. The jack bars are sleeved together and are left in the concrete as vertical reinforcement. Forms are elevated by turning with an iron bar a threaded sleeve resting on top of the jack.

When the screw jacks are being used there are bolted to the inside of the legs near the bottom two clip angles, one on either leg. These clip angles are slipp under the circumferential wales that hold the form sheeting in place. The form for each storage section, whether it be a circular bin, an inner space or an outer space, is rigidly constructed of 2 x 4-in. pieces. Upon this frame the decking is placed. Thus the clip angles support the forms and decking and themselves are supported by the screw jacks resting on set concrete. From the jacks are also suspended outriggers from which workmen apply the finish of neat cement to the bins.

Materials Handling

One of the interesting features of the construction of the elevator was the manner in which concrete aggregate and cement were handled. All the concrete materials were barged to the site, there being no direct rail connection. The gravel was premixed according to the concrete mixture desired and stockpiled on the site. The plant layout included two hoist towers, each approximately 160 ft. high; two aggregate bins, each with a capacity of about 65 cu.yd., and an elaborate belt-conveyor system. The aggregate was stockpiled at the north end of the site and the cement shed was built at the southern end. A belt conveyor ran from the aggregate stockpile to the first bin situated about 100 ft. from the end of the elevator and then across to the other bin situated at the same distance from the southern end of the elevator. Likewise the belt conveyor from the cement shed ran from the shed to the first bin and then to the north end of the elevator. For the aggregate conveyor there was a two-way spout which discharged either into the near materials bin or carried on across the intervening 200 ft. to the other materials bin. Likewise cement was sent from the cement shed to its near materials bin where workmen took it off or allowed it to proceed to the farther bin where it was discharged. In this manner each of the two mixers was kept continuously supplied with concreting material from one stockpile of aggregate and the cement shed.

From the hoist towers the concrete was handled through either one of two movable hoppers, each of

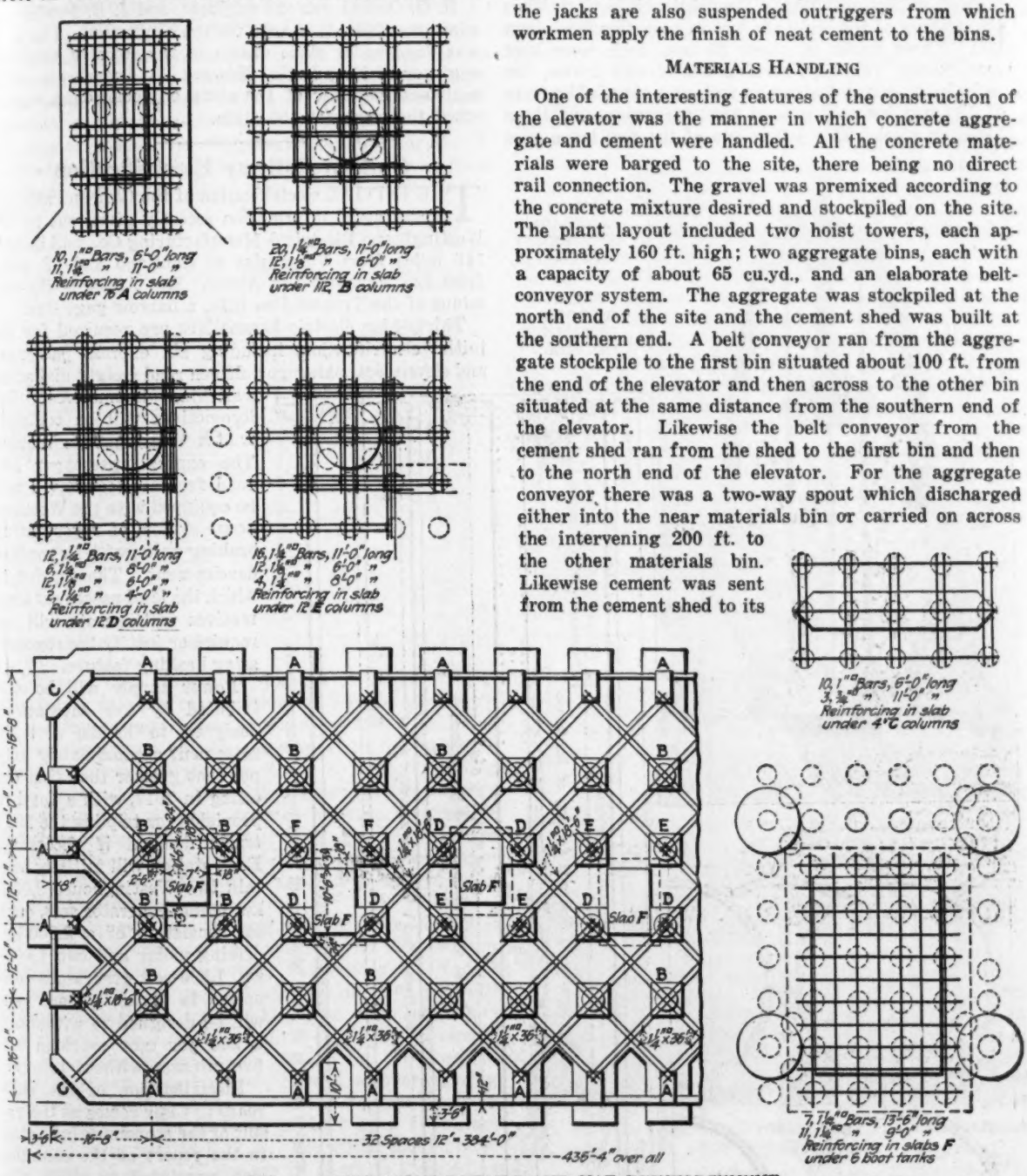

10, 1" ø Bars, 6'-0" long
11, 1⅛" ø " 11'-0" "
Reinforcing in slab under 70 A columns
20, 1¼" ø Bars, 11'-0" long
12, 1⅛" ø " 6'-0" "
Reinforcing in slab under 112 B columns
12, 1½" ø Bars, 11'-0" long
6, 1⅛" ø " 6'-0" "
12, 1⅛" ø " 6'-0" "
2, 1¼" ø " 4'-0" "
Reinforcing in slab under 12 D columns
16, 1¼" ø Bars, 11'-0" long
12, 1⅛" ø " 6'-0" "
4, 1¼" ø " 8'-0" "
Reinforcing in slab under 12 E columns
10, 1" ø Bars, 6'-0" long
3, ¾" ø " 11'-0" "
Reinforcing in slab under 4 C columns
7, 1⅛" ø Bars, 13'-6" long
11, 1¼" ø " 9'-0" "
Reinforcing in slabs F under 6 boot tanks
Slab F
32 Spaces 12'-0" = 384'-0"
436'-4" over all

FIG. 2. FOUNDATION DETAILS AND MAT REINFORCEMENT

which was set in the approximate center of one-quarter of the floor area of the elevator bins. From these four hoppers the concrete was wheeled in buggies to its place in the wall. About 42 men were all that were required to pour the concrete on the top of the bins and the number of men included in the construction work when the pouring of the bin walls was in operation was about 300. Three crews of about 35 men each were kept continuously employed jacking the sliding forms, the jacks being elevated about an inch at a time. The force of 300 men included ground men, carpenters and those handling steel. This job is one of the few large ones on which numeral steel reinforcing bars have been used and the contractor's engineer took occasion to remark upon the ease with which identification of numeral steel could be made by the average workman, thereby facilitating its placement.

H. G. Onstad was the engineer, and J. B. Fowler, the superintendent, in charge for the contractor. The work was done under plans drawn in the office of the state engineer of New York. Edward W. Anderberg, senior assistant engineer of the state engineer office, supervised the work for the state.

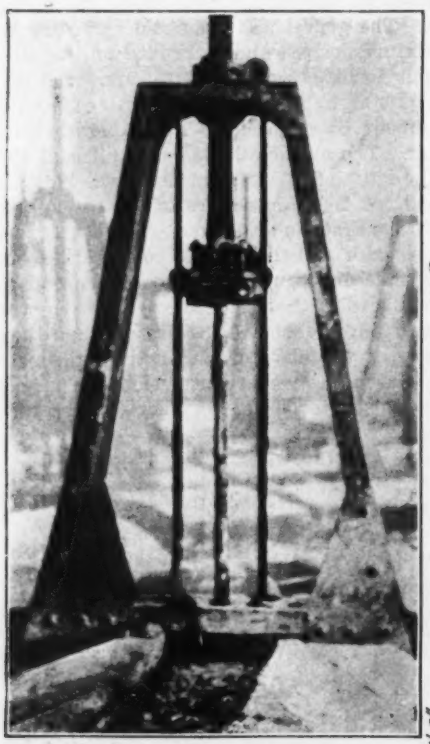
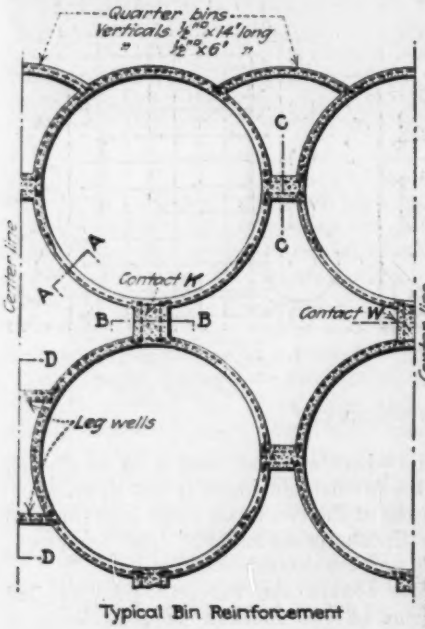
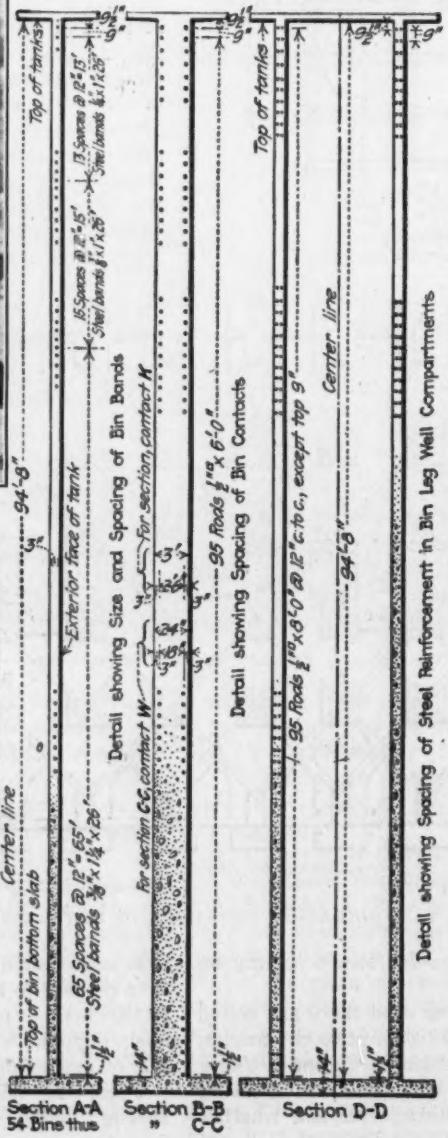


FIG. 3. (LEFT) CLOSE-UP OF SCREW JACK

FIG. 4. (BELOW) DETAILS OF BINS




Top of tanks
Exterior face of tank
Detail showing Size and Spacing of Bin Bands
for section, contact W
for section CC, contact W
Detail showing Spacing of Bin Contacts
Center line
Detail showing Spacing of Steel Reinforcement in Bin Leg Well Compartments
Top of bin bottom slab
Section A-A 54 Bins thus
Section B-B "
Section C-C
Section D-D

Chilean Railway Electrification

THE INITIAL electrification of the Chilean railways, according to information recently given out by the Westinghouse Electric & Manufacturing Co., will include 116 miles from Valparaiso to Santiago and 28 miles from Las Vegas to Los Andes. Los Andes is the terminus of the Transandine R.R., a narrow gage line.

Thirty-nine electric locomotives are required for the initial electrification, including six express passenger and eleven local passenger, fifteen road freight and seven switching locomotives. All locomotives will be equipped with Westinghouse motors. The express, passenger and road freight locomotives will be equipped with the Westinghouse system of regenerating braking units, with its modern development. The service in which the local passenger locomotives will operate will not require or justify the regenerating braking feature.

Power supply will be distributed by five substations designed to handle a train movement approximately fifty per cent greater than that existing in 1917, with a further provision for tripling the 1917 traffic demand if necessary. Each station will initially contain two Westinghouse 2,000-kw. motor-generator sets, each set consisting of a 2,800-hp. driving motor and two 1,000-kw. 1,500-volt generators connected in series. These sets will be designed to withstand a 200 per cent overload for five minutes without injury.

Electrification of the railroads in Chile comes as the result of the economies indicated in the report of the commission appointed to study the problem of electrifying all broad-gage lines. The Valparaiso, Santiago and Los Andes branches comprise the broad-gage road in the first zone.

A loan of $10,500,000 for this purpose was subscribed.

Traveling Forms Cut Expense in Pouring Concrete Stadium

Timber for Formwork and Labor Involved in Erection and Stripping Reduced to a Minimum—One Form Used for Eight Bays

THE amount of lumber used in the formwork for the construction of a concrete stadium in Pelham Park, New York, was reduced to from one-sixth to one-fourth of what would otherwise have been necessary through the use of a novel traveling form designed for the T. J. Buckley Engineering Co. by E. E. Seelye, consulting engineer, New York City. The stadium is part of a playground development being built in Pelham Park, the funds for the construction of all the structures in the development being supplied by Mrs. I. L. Rice.

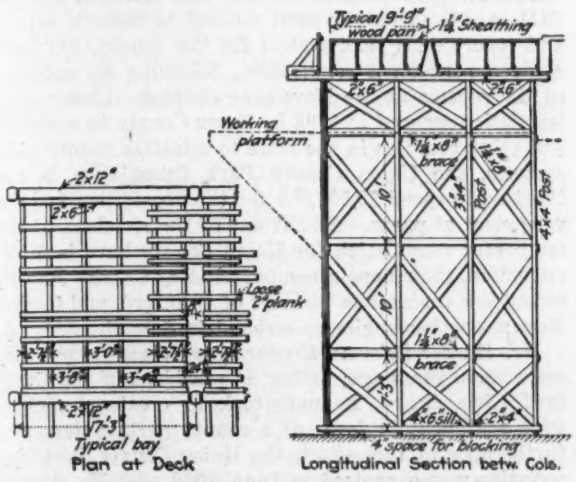


FIG. 1. PLAN AND ELEVATION OF TRAVELING FORM

The playground will be a memorial to her husband. Beside the concrete stadium, there is to be a running track with a 220-yd. straightaway, an outside concrete swimming pool, a large stone bath house, a mother's house and miscellaneous structures. Mr. Seelye is the contractor's engineer for all the work and the same contractor, Thomas J. Buckley Engineering Co., is doing all the construction work.

The stadium is 324 ft. long and 106 ft. wide and is of reinforced concrete. In the rear of the stadium, though practically structurally independent of it, is a reinforced-concrete pedestal upon which rests a bronze statue, weighing 11 tons, of Mr. Rice. The columns of the stadium are spaced laterally 17 ft. 3 in. on centers and longitudinally, generally, 20 ft. 7 in. The two last bays at either end, however, have a smaller spacing. The line of columns at the rear of the stadium are 20 in. square, the next line in from the back 14 x 14 in., and the remaining four 12 x 12 in. The girder has an effective depth of 32 in. There are 29 risers in the stadium of a thickness of 4 in. and a height of 17 in. The treads are 3 ft. in thickness.

When construction upon the stadium was about to begin, the fact that a large amount of lumber would be necessary for formwork, if the forms for the entire structure were put up simultaneously, led to a study of methods which could be used whereby both the lumber and labor could be materially minimized. The result of the study was the design of the traveling form shown.

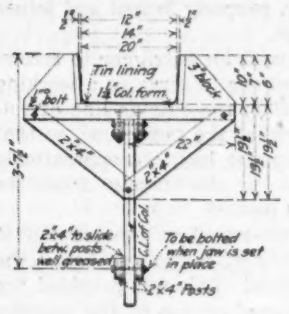


FIG. 2. DETAIL OF COLUMN FORM JAW

The traveling forms were built so that each area included between any four columns was a unit. This made each unit approximately 17 ft. 3 in. x 20 ft. and 7 in. However, forms were constructed for the entire width of the stadium and for the length of two bays. A typical bay unit was built up of 3 x 4 in. or 4 x 4 in. posts, braced horizontally at the bottom and at vertical intervals of 6 ft. x 1¼ in. x 8-in. bracing. Lateral bracing of the same dimension was used and the longitudinal bracing at vertical intervals of 6 ft. was also of 1¼ x 8-in. material. The posts were braced at the bottom by 2 x 4-in. pieces. The traveler was set upon four 4 x 6-in. sills, spaced equally in a longitudinal direction, and supported on 4 x 10-in.-mud sills. Four-inch wedge blocking was used to true up the traveler and when the forms were to be moved these were knocked out and rollers put in.

The travelers were so arranged that when in place they could be blocked and connected to make a continuous more or less rigid form the entire width of the stand and the length of one bay. The separate travelers extended only to the midpoint of the columns and the column forms were attached to extensible T-braced arms fastened to the traveler. To these arms were fastened collars to fit over the column forms. Enough of these extensible arms were installed, according to the height

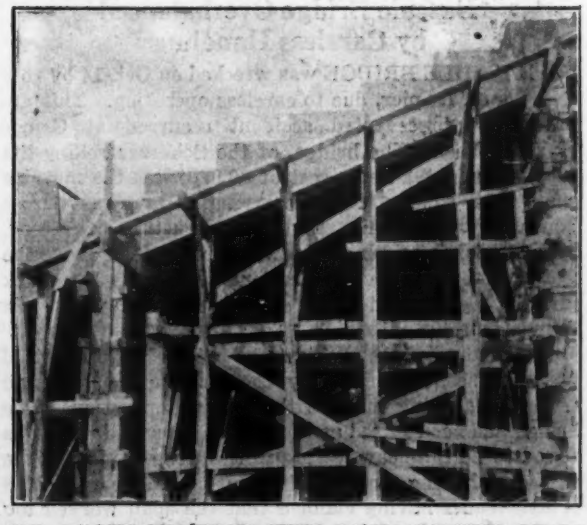


FIG. 3. ONE TRAVELER WITH PANS ADJUSTED READY FOR CONCRETING

of the travelers, so that they could be trued up and held rigid in their exact position.

The traveler was decked and upon the decks were placed the wooden form pans. There were 28 of these wooden pans all alike. They were built up of 1 x 4-in. lumber and were 2 ft. 3½-in. deep at the rear and 3 ft. 5¼ in. deep at the front and sides. Stiffeners 2 in. x 4 in. in dimension were used and these set upon the traveling forms. The pans were built 9 ft. 9 in. in

length, two pans to the bay, properly braced and joined at the mid-width of the bays.

The travelers were built with an outrigger to accommodate the girder forms and one to serve as a working platform. In pouring the slab, the outside line of columns and girder were poured at the same time, so that when the traveler moved up one bay, the approximate alignment could be secured for the traveler from the column and the girder thus poured.

In order to permit the movement of the traveler it was necessary to have a line of movement below the soffits of the transverse girders. This was provided for by the use of wood cores placed on top of the traveler which remained suspended through adhesion when the traveler was moved ahead.

When construction first began on the stadium, the traveling forms extending the width of two bays were joined and the two sections poured simultaneously with a 1-in. expansion joint at the center. The forms then were moved in opposite directions and poured alternately. After several bays had been poured, it was found possible to pour one entire bay in one 9-hr. day. The poured section was then allowed to set and work was done on the opposite side. With this system of form erection, concrete pouring and stripping, and removing ahead of travelers, the same gang of carpenters and concrete men was kept in continuous employment. The concreting plant was located directly in front of the center of the stadium and concrete was chuted from the hoist tower first to the rear of the stadium, thence it was chuted to succeeding lines of columns, girder and slab.

The architects on this work were Herts & Robertson, New York City.

Bascule Bridge Overbalanced by Careless Handling

A BASCULE BRIDGE was wrecked on Oct. 14 by rolling off its pier, due to careless operation. This apparently unprecedented accident occurred at Gray's Harbor, Wash. The bridge, of the Scherzer rolling-lift type, built in 1914 at a cost of $9,220, was the movable span in a timber trestle carrying a highway across South Bay. It was a single leaf structure of 110 ft. span and 16 ft. width of roadway, about 10 ft. above the water and built for operation by hand. Its track girders were carried on concrete piers with pile foundations.

At the time of the accident the bridge had been fitted with a gasoline engine by the local authorities and trials were being made with machine operation. The bridge had been raised and lowered on low gear and was found to be tail-heavy owing to the wood paving of the roadway having become dried out and worn. The bridge tender having claimed that the span worked too slowly, it was decided to shift from the low to the high gear, but no attempt was made to block the bridge, and it is evident that the brakes were not applied. When the gear was in neutral the bridge, being free, began to rise owing to its being tail-heavy, as noted above.

As soon as it was partly open, a high wind accelerated its movement. Those in attendance ran for safety. Even then the bridge might have been saved if the trestle approach had been built as designed, with pile bents directly under the concrete counterweight in its lowered position. Instead of this, the counterweight landed on a span of wood stringers, which broke, allowing the counterweight to fall and the moving span to roll off the track girders.

No injury was done to the foundations or piers or to the track girders and the tower, these latter parts representing about 40 per cent of the steel in the bridge. Part of the span has been salvaged and work is in progress for the recovery of the rolling heel girders and the machinery. Meanwhile a ferry service has been instituted.

New Jersey County Adopts Park System

THE temporary park commission for Union County, N. J., noted in *Engineering News-Record*, July 7, 1921, p. 21, as having been created to make a survey and report on a park system for the county, has been made a permanent commission, following an approval of the scheme at the November election. Under state legislation secured in 1895 by Essex County to enable it and other counties in the state to establish county park systems, the Union County Park Commission is authorized to spend $2,500,000 for the acquisition and development of parks. All but one of the members of the temporary commission for Union County have been reappointed, the reappointments including Charles Hansel, consulting engineer, a resident of Cranford, and Caxton Brown, another engineer, resident in Summit.

Mr. Hansel informs *Engineering News-Record* that some three years ago, acting as president of the Cranford Civic Board, he undertook to create a county-wide sentiment in favor of a county park system. In furtherance of this effort, the Union County Park Association was organized in June, 1920, and Mr. Hansel was made its president. This association conducted educational work that resulted in a petition being presented to the presiding Supreme Court justice to appoint the temporary park commission already mentioned. The petition, signed by 32 civic and other non-political organizations, was presented in April, 1921, since which the events already mentioned have occurred.

Preceding the recent election the members of the temporary park commission conducted a campaign throughout the county to enlist support and secure a popular vote for the authorization of the permanent commission. Members of the County Park Association joined in the work. Addresses were made before civic bodies, town councils, women's clubs, and in moving picture theaters. Prizes for the best essay on a county park system were offered through the schools, and committees of school principals and teachers were posted on the subject generally.

Massachusetts Law Controls Tank Construction

In Massachusetts the construction of "tanks or containers for the storage of fluids other than water" is controlled by a law which requires that permits for constructing, maintaining or using any such tanks must be obtained from the chief of the district police (in the metropolitan district, from the fire prevention commissioner). These officials are required to make rules and regulations for such tanks, subject to the approval of the governor and council. The law, which was passed as a result of the Boston molasses tank accident in 1919, does not apply to tanks constructed principally of wood, or to tanks of 10,000 gal. or less capacity.

Training the Engineer for Industrial and Social Service

Two Engineering Educators Discuss the Professional and Non-Professional Opportunities of the Young Engineer and the Length of Course Justified in Preparing Him for Service

The following papers, by Prof. Frederic Bass and Prof. Hale Sutherland, were stimulated by Prof. Burr's discussion on the six-year course in engineering before the Society for the Promotion of Engineering Education at New Haven last June.

Both authors lay great stress on the need for a broader training and both base their arguments on a high professional conception of the function of the engineer. Prof. Bass holds that the engineer has an unexampled opportunity to project his ideals of service into public affairs and industry; Prof. Sutherland's argument, while differently expressed, has the same purport.

The papers deserve a thoughtful reading by all who are interested in the closely related topics of engineering education and the status of the engineer.—EDITOR.

* * *

Projecting Professional Ideas Into Business

By Frederic Bass
Head of the Department of Civil Engineering, University of Minnesota

A NUMBER of arguments have been presented in favor of the proposition of a six-year curriculum for engineers the first three years of which would be devoted to a liberal training in fundamentals. One of them is that it would eventually result in securing for the engineering profession its proper place in public esteem. This may be a desirable result of such a curriculum but it cannot be considered as an adequate objective. A calling meriting the distinction which attaches to the term "profession" must require of its members an obligation to render service individually and collectively beyond the remuneration or immediate recognition which they receive for their labor. The soldier, the priest, the physician, the lawyer, all are accorded a professional status because their lives are primarily devoted to the solution of the great human problems of preservation of social order, spiritual welfare, prevention and cure of disease, and the administration of justice. It is true that all members of these professions do not take this view of their occupation, but that does not invalidate the definition of a profession. All engineering societies announce service to mankind as the purpose of engineering. Altruism is the essential motive of a profession.

Trusteeship of Wealth

The engineer may look forward to the day when his calling will be accorded a professional standing, but only when the preponderance of engineering thought and conviction is based upon the conception of engineering activity as an agency for devising economic and just solutions of the greater problems of production and distribution. Engineering practice has grown up from the constructive arts as applied to materials; it later adopted the methods of science and developed enormously, particularly in the last half-century, but has been generally considered as limited to mechanical or chemical achievements. An increasing proportion of men receiving a formal institutional training has entered its ranks, men who sense the limitations of the mechanical concept and who realize after having mastered the technic of their chosen province that they have been out of touch with the greater human forces underlying their occupation. Engineering is a part of business and most business today is conducted with an overwhelming regard for immediate profits. While profit is necessary for the continuance of business, the professional man, as a participant, must regard profit as subordinate to the real needs to which the business ministers. A business conducted upon this principle will possess a stability which enables it to successfully meet irregular demands for its product as well as interval disturbances. The professional man, in business or out, must regard himself as a trustee of wealth. This viewpoint is not lacking among the ranks of many of the great financiers and business men of today, nor among the leaders of public life. These men are building for the future in a large way.

Since engineers are, because of the need for their scientific training, entering the management field which includes the technical field, they have before them the prospect of taking an important, if not a dominating influence, in the conduct of commerce, industry, and public affairs, provided that is accepted as the objective of their training. If the engineering fraternity becomes sufficiently impressed with the value of the training now received in engineering schools in accurate observation, correct analysis and interpretation, and the design or formulation of constructive programs, can visualize its beneficial application to business, public and private, can add to it the professional sense of trusteeship, and can bring pressure to bear upon engineering education to accept this greater range of vision, engineering need not remain a subordinate occupation; it will attract the highest type of man because his opportunities will not be subject to the limitations of the present.

Length of Course

If it be the objective of engineering to provide merely for the routine investigation, designing, construction and operation of structures and equipment used for production or distribution, the usual four-year college course is probably too long, but if it be the mission of engineering to carry its analytical and synthetic methods into the business of which it is a part, then the four-years' course is insufficient either to attract or to train the type of man who must master not only material but great social and economic problems. Not only a longer course of study is needed but a different type of study, one motivated by an ideal and provided with a practical program.

Mathematics and physics are generally regarded as the sole fundamental studies in an engineering course because they supply the knowledge of natural law and the means of correctly interpreting it. But a comprehensive knowledge of history, political science and economics is none the less essentially fundamental in the training of the engineer of the future. Not only should these subjects be included in a professional engineering curriculum, but they should be connected definitely with the problems of industry. Frequently the engineering student has an opportunity to get a smattering of these subjects, or of their subdivisions, but they are often regarded by him as incidental, because taught as having only incidentally a relation to engineering. The same observation may be made of means of personal expression. The engineer is usually taught to express his thought almost exclusively in the form of mathematics, graphical drawings, and structural or machine design. Excellent as are these concise means, he almost universally is deficient in the facile use of written and spoken language. His poverty in this respect is the subject of common observation. He is confined too exclusively to his adopted method and thereby loses the power to communicate with groups of men whose thought runs perhaps in parallel but different channels. The engineer's training tends to narrow channels which are frequently worn so deep that he, working industriously at the bottom, never looks over the top, and often cannot if he will. The usual engineering course needs more language, both oral and written, English and foreign.

The engineering student needs to know where his work in its simpler phases impinges upon that of individuals and groups in other occupations and professions; as a practicing engineer later he will then appreciate where it overlaps and merges in more complex situations and the path which his non-engineering associates have travelled in arriving at the

point of juncture with him, as well as the ground which they occupy at the time. Every professional engineer should better understand non-engineering people and their various modes of thought, expression and action, the reactions among groups, and especially their significance at this unprecendented period of world history.

Curricula of Various Lengths

Having set an ultimate objective and marked out some of the means by which it may be reached, it becomes possible to discuss the features of an education which will prepare engineers for their destinies. The plan of a six-years' course, the first three years given to a course in the college of liberal arts followed by three years in engineering, presumes that a broad foundation is laid in the first period. A foundation suitable for any superstructure generally requires some preliminary excavation, which in the situation before us means an opening of the student's mind by exciting his interest and motivating his study. The means by which this can be done must be by a co-ordinated curriculum, administered by men who know its meaning and purpose. Many of the instructors in the junior years of colleges of liberal arts today are themselves highly trained specialists who have won their places by research in restricted fields. Moreover such colleges are as a rule divided into departments, one might almost say compartments, without sufficient means of inter-communication. If the earlier years of a student's course can be so planned that he can pursue courses in English, economics, political science and language in parallel with engineering and have their inter-relations made evident to him there can be no doubt but that an ideal training would result, but this correlation should be assured before such a plan as Professor Burr purposes is adopted. As expressed by Dean Cooley of the University of Michigan, a "ribbon" system instead of a "block" system should be used. The ribbons should be woven into a substantial fabric.

The point is made that all of the students desiring to pursue engineering cannot afford to do so if the course is made as long as five or six years. This is no argument at all; there are today many boys desiring to study engineering who cannot afford to take the necessary four years from productive effort; should we therefore reduce the course to three years or one? There is nothing inviolable or sacred about the figure four; if the demands for the best service which the engineering profession can give require five or seven years, then it becomes the duty of the engineering schools to furnish that training.

Probably the lengthening of the curriculum would result in fewer students. No doubt it would at first, have a very marked effect of this character, and possibly a permanent one. This would leave the demand for draftsmen and field, shop or office assistants unsatisfied. It is in all probability true that a considerable number of young men enter and graduate from four-year engineering courses who would have done better both for themselves and the colleges in which they studied to have terminated their course at the end of two years. These are men who have the type of mind that develops almost wholly through practical experience, men who may be satisfied with or who may be limited to action in the more restricted fields of engineering. Concurrently with the introduction of longer courses in engineering, the present four-year courses should be retained or better shortened to three or two years and as experience dictates, revised in character. Graduates from such courses should be given a certificate of graduation, possibly conferring a title, such as: "Graduate in Engineering from Junior College."

The writer is of the opinion that these shorter courses should be offered in universities only in localities where there are no other schools to give them, such as Wentworth Institute in Boston or the Dunwoody Institute in Minneapolis. State universities must, on account of the expediencies of their situation, often develop with less freedom than the endowed universities and consequently be required to administer courses not really of collegiate grade.

In any course of engineering, it is the opinion of the writer that a close identification of the student's classroom work with the practice of engineering and with industry should be maintained. It required enormous persistence, patience and labor to establish the co-operative courses at Cincinnati, but the experiment has been successful and in modified forms the plan is being followed elsewhere.

It cannot be maintained as a simple proposition, that all engineering courses should be standardized at six instead of four years. But it can be truly said that the engineering profession has before it a formidable task in projecting its ideals of service and its scientific methods into public affairs and industry and that in this greater task a more broadly-trained engineer will be required than in the past. The combined efforts of teachers of engineering and of the most farsighted men of practice in engineering will be necessary to study the present situation in the light of future demands in order that a well-balanced program may be formulated for the training of members of the future profession of engineering. Such a study should be amply financed over a period of several years.

* * *

Visioning the Opportunity of the Engineer

By Hale Sutherland

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THAT ANY particular engineer is a professional man is often a very debatable question: That engineering is a profession can hardly be questioned, although its qualified practitioners, fully entitled to professional status, are not yet sharply defined as a legal group by any general system of licensing as is the case with our doctors and lawyers. The clear-cut definition of the Century Dictionary may be used to establish this contention: A profession is a "vocation in which a professed knowledge of some department of science or learning is used by its practical application to the affairs of others, either in advising, guiding or teaching them or in serving their interests or welfare in the practice of an art founded on it. * * * The word implies * * * an application of such knowledge to uses for others as a vocation as distinguished from its pursuit for one's own purpose."

In arguing the case the tendency often has been to emphasize the technical qualifications of the engineer, the extent and depth of his specialized knowledge, and his expert judgment. But an essential element of professional work is the application of this expert knowledge to the use of others. The professional man deals always with clients to whom he owes a peculiar loyalty, yet he may not favor one client at the expense of another and in the largest sense his loyalty is to society, the sum of all possible clients. The humanitarian ideals have always bulked large in the thought of the learned professions and the masses have always turned to these groups for leadership even outside their limited fields of professional knowledge.

This standing apart of the professional man as bound by purpose to a larger end than his own individual advancement is of immense significance. The struggles of opposing interests and ideas in our civilization today are so tremendous, the results so uncertain and of necessity bound to be so far-reaching that the average man stands uncertain and aghast. He is sure of but one thing and that is that there must be less of conflict, more of co-operation, and this principle he applies to the solution of all difficulties, large and small. In this judgment he is supported by the sociologists who tell us that the advance of civilization is measured by the advance of the idea of co-operation. Now the spirit of co-operation is pre-eminently the spirit of the professional man and one writer has gone so far as to say that society progresses in the measure that additional groups of workers take as their own the standards and purposes of the profession. So in the larger view of things the demand of the engineer to be counted as standing with the minister, the doctor and the lawyer, is not a mere seeking of selfish preferment, but is a declaration of his recognition of his function in the work of the evolving race, of his duty to place his specialized knowledge at the disposal of society for the advancement of all. Anyone who has read of late the writings of engineers supporting their claim

cannot have failed to note the large place taken by the thought of community loyalty.

The justice of Prof. Burr's plea for the full professional training of the engineer is therefore easy to establish. Every engineer should grasp the full significance of the demand he makes when he seeks recognition as a professional man. No engineer can understand the significance of this claim and merit the higher rating unless he has gained a sympathetic knowledge of mankind's advance up from the savagery of the prehistoric past into the complex and disordered present. Only such knowledge can face intelligently and without prejudice the pagan logic of the reactionary and the maudlin sentimentality of the radical whose clamor confuses our ears these days. Wisdom and good will are needed to solve the problems that threaten civilization and the professional man is bound by his loyalty to a leading part in their solution.

Historical Knowledge Needed

The sympathetic knowledge that will command this loyal purpose must of necessity include certain definite subjects: The story of the life of man on this globe from his earliest beginnings to the present, the story of the various community groups he has formed and now maintains, their varying fortunes, the organization and direction of these groups, the ways in which they have made and now make their living, the nature of their environment, the laws of the natural world in which man lives, and the efforts he has made to arrive at an understanding of life by rational inquiry and by emotional evaluation. History, the humanistic sciences (sociology, economics, government), natural science and mathematics, philosophy, literature: Here are five fields of learning in which a man must have real understanding if he is to comprehend the significance of the vast evolutionary procession in which we move and work intelligently for progress. And of course to perform his special task in society the professional man must have expert knowledge and ability in his chosen specialty. Can the engineering profession do less than demand that in the future its members receive a training of this scope?

One of the most vital and interesting of recent contributions to educational discussion is Mr. H. G. Wells' proposition that the backbone of education is history. He is asserting the same thesis that is here maintained, that the schools should open to us the broad horizons of the evolving world race and set our own interests and purposes to racial ends. He is not greatly interested in dynasties and dates but he is very much concerned with getting a clear picture of what man is like, his ways, thought and doings, past and present, that explain man today and the world situation by which he is faced. He makes this background of the past and the vast conflict of the present very live and real in his "Outline of History." One comes from a reading of that book with a vivid idea of what the word "history" really means and with a vast aversion to the scholastic deadness that so often masquerades by that name.

"Scholastic" Knowledge Deadly

As history requires to be related to the living processes of the present so all subjects are under the same necessity if they are to have living force. That which is studied for itself, for its own interest or beauty, is a scholastic, a dead thing. When this principle is adhered to a course in Latin has living value: What are our memories of our schoolboy Latin? When this principle is disregarded our courses in history, social science and literature become dead and vapid scholasticisms. So it is not enough to outline a curriculum. Nor will it be enough to specify, "All courses shall be so arranged and taught that the significance of the subject in the life story of humanity shall be plain." The end can be attained only by ensuring that our teachers be men of vision first and scholars second.

The colleges are in a very self-depreciatory mood at the present time. They complain that their graduates are narrow in range of knowledge and interest and too often self-centered in their view of life. Our engineering schools join in these complaints and add that the average of student technical ability and initiative is far from what it should be. Of course the prime trouble lies in the roots of human nature, in our inertia, our content to remain without understanding and to live on the plane of least effort: or briefly it lies in our being asleep, unaware of the tremendous drama in which we move and of the immense possibilities that await the active player of his part. The schools have failed because they have not awakened their students to life and action. They have not awakened their students because they have not convinced them that there is any vital connection between their studies and the daily life of the world, because they have not introduced eager young minds to the fresh and stirring human problems that awaken imagination and purpose. (A fine statement of the problem is to be found "The Liberal College" by President Meiklejohn of Amherst. The outline of the fundamentals of liberal knowledge here given follows his argument.) The curriculum is largely to blame in all this: it contains too much of the scholastic: its range is limited, leaving great gaps in the student's knowledge of life. We teachers are more to blame; we have taught too much from the academic and not enough from the human point of view: we have not had enough life in ourselves to awaken life in others.

Conclusions

Perhaps at the present stage of growth of our race these failures were inevitable. We all know how few are the men and women whose horizon extends beyond their own petty concerns and how heavily our own spirits move. But in endeavoring to set forth the essentials of a proper training for the engineering profession we should face these failures and do what we can to ensure that henceforth the young men who receive our engineering degree not only shall have been made familiar with a certain range of facts and ideas, but that they shall possess, as a class, vigor of mind and life, broad sympathy and purpose, qualities that grow with properly directed labor in humanistic studies. Properly speaking, then, this end should be attained as a result of the strictly collegiate work and such should be the sturdy quality of the men who matriculate in engineering henceforth.

A large part of the difficulties of technical education will disappear when the men who seek that training come to our schools with alert and vigorous mental power. The present immaturity and low average of ability result in courses definitely low in standard of rigor and accomplishment. The rest of the reform in technical schools is largely one of detail—the pruning of overcrowded curricula and courses, the maximum possible elimination of the merely informational, the giving of more time to economic and industrial factors, increased emphasis on disciplinary studies and basic principles.

Compensation Damages for Typhoid Death

The Ohio Court of Appeals has decided that "death from typhoid fever caused by drinking impure water is compensable under the Workmen's Compensation Statute" of Ohio (decision of Sept. 12, 1921; the Industrial Commission of Ohio v. Cross et al). The decision is thus summarized in *Public Health Reports*, Nov. 11, 1921. "The decedent was employed by the city park department as inspector of certain construction work. The only drinking water available in the vicinity of the place where the construction work was being done was from a spring near by. After the decedent was taken ill, the spring water was examined by the health department and found to contain typhoid fever germs. In the course of the opinion the court of appeals said: 'While there might be an extended discussion and difference of opinion as to what is meant by the term 'injured,' in construing the term as used in the statute, we do not think the legislature meant that the injury must be caused by the application of external force. The man was as much injured by the contracting of typhoid fever as if injury had been inflicted by external force.'"

Suldbach Tests: A Swiss Study of Bridge Action

Exhaustive Measurements on 63-Foot Single-Track Pony-Truss Span Under Test Axle and Lateral Loads—Continuity of Stringers—Chord Stress in Floor—Top-Chord Bending

A REMARKABLE study of bridge action carried out in Switzerland throws valuable light on questions of continuity due to interaction of the separate elements of truss bridge framework. It affords the clearest picture of the behavior of a pony-truss structure that has ever been obtained experimentally, and it defines the interrelation of the various parts of the floor construction and their relation to the bottom chord and crossframe construction virtually for the first time. No publication of the data or the results has yet been made, although the tests were carried out three years ago. The following abstract of the investigation is based on a manuscript copy of the report, supplied by M. Rôs, secretary of the Swiss Bridge Builders and Structural Fabricators Association, which carried out the work as part of the ambitious research-test program outlined in *Engineering News-Record* of June 30, 1921, p. 113.

Bridge Data.—The bridge tested is a single-track railway span, one of a pair on double-track line of the Lötschberg Ry. over the Suldbach near Mülenen. It is a pony-truss parallel-chord span 63 ft. 4½ in. long center to center of end bearings, comprising eight panels of 7.92 ft. each. The trusses are 7.89 ft. deep center to center of web connections, and 8.18 ft. deep over all. The roadway width center to center of trusses is 16.42 ft. and the two lines of stringers are spaced 5.90 ft. apart. The panel length of the bottom lateral system is two truss panels. The truss web system comprises posts at all panel points and crossed diagonals in each panel. The rails rest on wooden cross-ties on I-beam stringers.

The truss chords are single-web T sections consisting of a web plate 14 x ½ in., two angles 3⅛ x 3⅛ x ⅝, and one or two cover plates 14 in. wide. The posts are star sections of four angles 2¾ x 2¾ x ⅝ in.; the compression and counter diagonals two 7-in. channels or two T's back to back, the tension diagonals two 7 or 9-in. flat bars. The floorbeams are 20-in. plate girders connected to the posts by triangular bracket plates extending the full height of the posts, 22 in. wide at the base (24 in the case of the end post) by ⅜ in. thick, spliced into the floor-beam webs. The stringers are single 12¾-in. I-beams.

Test Methods.—All the tests were made under *static* loading, using a single concentration of known amount. For vertical loading, a single-axle test load of 24.9 metric tons (27,440 lb. per wheel) was provided. The test axle was arranged at mid-length of a four-wheel truck, with vertical adjustment enabling the full weight of the truck to be concentrated on it when in position for test. Horizontal loading of the top chord was provided by a straining tackle with spring-scale dynamometer (Fig. 1), which could be put in place between the top chords and by which a horizontal force of 4,408 lb. acting to pull the top chords together was applied.

Measurements of stresses, deflections and slopes were made on various members of floor, trusses and laterals, usually under a succession of different positions of the test load. In most instances the results were plotted in the form of influence lines (showing the variation of effect at a given point under a traveling load, plotted along the travel of the load). The deflection and slope measurements checked closely with the stress measurements, but in some cases the former served to bring out a particular effect more prominently. A sufficient number of extensometers was used at any one measuring point (compare Fig. 1, right-hand view) to give the stress at the principal corners of the cross-section, so that the true mean stress could be determined as well as the amount of vertical and lateral bending and torsion. The torsion of various members was determined directly by clinometer measurements, which were also used in determining the change of slope of a point on floorbeam, post or stringer during the travel of a load.

The tests with horizontal force applied to the top chord gave little or no information additional to that furnished by the vertical-load measurements. Tests with simultaneous horizontal and vertical loading con-

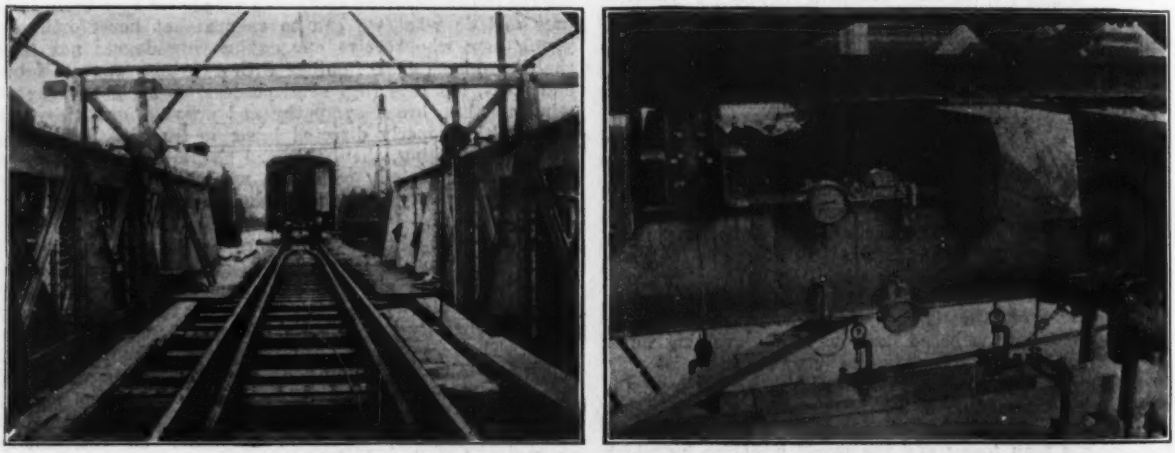


FIG. 1. STRESS-TEST ARRANGEMENTS ON SULDBACH BRIDGE
At left, strain yoke for lateral loading of top chord; test truck in rear. At right, extensometers, deflection recorders, and clinometers on stringers.

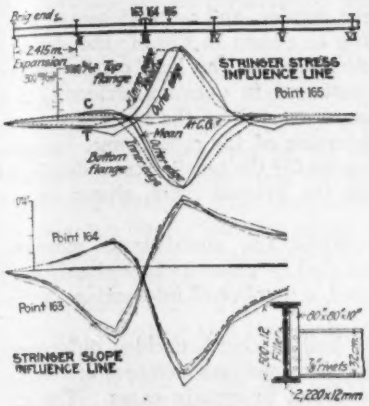


FIG. 2. STRINGER STRESSES; INFLUENCE LINES FOR STRESS AND SLOPE

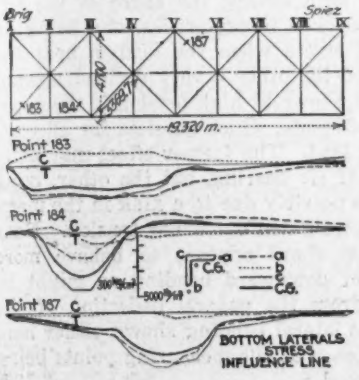


FIG. 3. STRESSES IN BOTTOM LATERALS

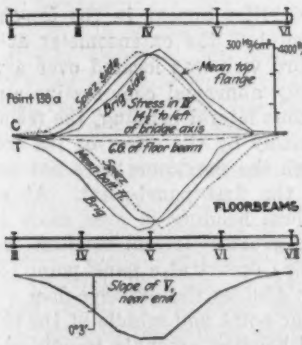


FIG. 4. FLOORBEAM STRESS AND SLOPE INFLUENCE LINES

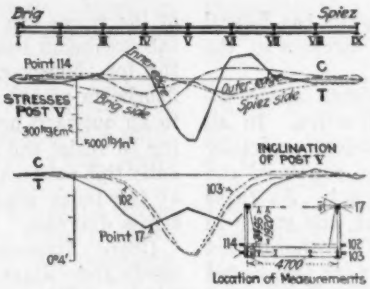


FIG. 5. BENDING IN POST BRACKET PLATES

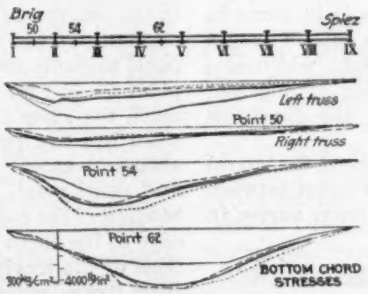


FIG. 6. VERTICAL AND LATERAL BENDING IN BOTTOM CHORD

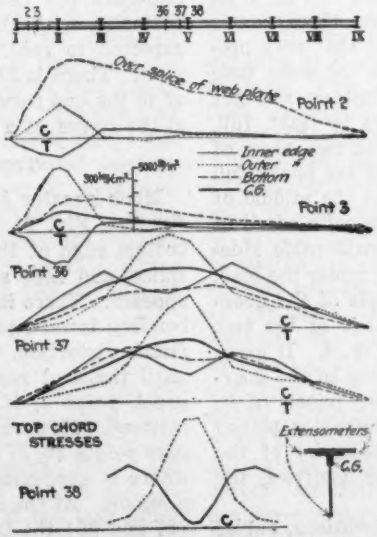


FIG. 7. TOP-CHORD STRESS INFLUENCE LINES

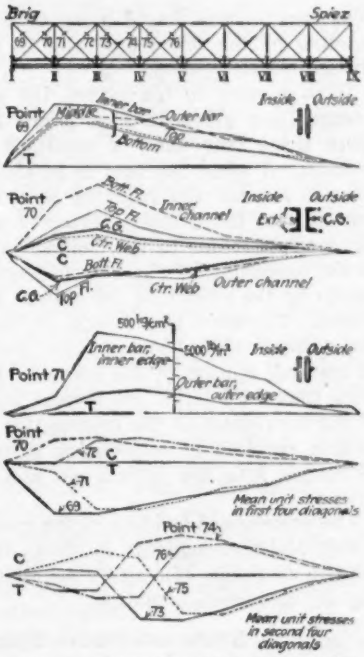


FIG. 8. DISTRIBUTION OF STRESS BETWEEN TWO WEB SYSTEMS

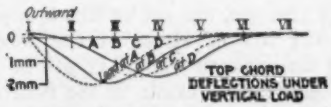


FIG. 9. TOP-CHORD BENDING UNDER VERTICAL LOAD; ELASTIC CONTINUITY

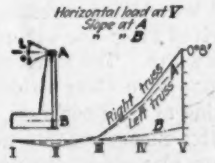


FIG. 10. CLINOMETER READINGS ON CROSS-FRAMES UNDER HORIZONTAL LOAD AT MIDSPAN

firmed the applicability of the rule of superposition. With a single exception, the following summary reports only vertical-load measurements.

Stringer Continuity.—Some typical results of the stringer measurements are shown in Fig. 2. Curves are given of flange stress at the third-point of the third panel, and of angular deflection at points in the second and third panels close to the floorbeam between these panels; all the curves are drawn as influence lines. They exhibit the continuity of the bottom chord at first glance. The stress curve, which is rather more symmetrical and consistent than those obtained in some of the other panels, is remarkable in indicating the effect of the general deflection of the span and the floorbeam deflection; reverse bending does not begin as soon as the load passes off the stringer, but only when the load has passed some distance beyond the first tie in the next span. The sketch of the stringer connection to the floorbeam given in the figure shows that the attachment is not superior in rigidity to that ordinarily used.

The measurement of slope at two cross-sections in adjoining panels, these sections being on opposite sides of the same floorbeam, brings out the continuity of the stringers even more clearly, though the difference between the curves for the two points is not explained by the data.

The curve of stress at center of gravity of the stringer, derived from the measured flange stresses and shown by dash-and-dot lines in Fig. 2, theoretically indicates participation of the stringers in the transmission of bottom-chord stress, but the effect is considered to be within the limits of experimental error. The effect of

floor tension was found more definitely in the lateral bending of the floorbeams and in the stresses of the bottom lateral system.

With respect to the latter, the specimen stress influence lines given in Fig. 3 are instructive. In all three cases they show a resultant tension, especially pronounced when the load is in the two panels of the laterals nearest the point of measurement. As these curves were taken under vertical loading, the stress in the laterals is due to the elongation of the chords and to the spreading of the bottom chords near the loaded panels by the stretch of the bottom flanges of the floorbeams. Probably the stretch of the bottom flange of the stringer while bending under load also plays a part in creating tension in the laterals. It is to be borne in mind that the laterals are riveted to the bottom flanges of the floorbeams at the intersection points, which connection resulted in introducing a number of apparent anomalies into the lateral as well as the floorbeam stresses.

The pronounced bending in the members of the lateral system and the inequality in stress distribution between the two diagonals of a single panel (see lower curves in Fig. 3) also invite attention.

Beam and Chord Behavior

Floorbeam Stresses.—Continuity of the floor is further demonstrated by the measurements of floorbeam flange stresses, one set of which is plotted in Fig. 4, an influence line of stress of the floorbeam three panels from the expansion end. It will be seen that very pronounced bending exists in the floorbeam for some time after the load has passed off the tributary stringer panels. The four separate curves shown by light, full, and dotted lines respectively represent the two edges of upper and lower flanges respectively, and the heavy full lines (derived from the others) refer to the middle of the flange width. The stresses in the opposite edges of either flange give clear evidence of considerable sidewise bending of the floorbeam, reversing under the load.

Clinometer measurements near the ends of the floorbeams were also made during the passage of the test load; one influence line is included in Fig. 4. It gives evidence that there was downward bending in the floorbeam while the load remained within two panels of it, and thus tends to show that the truss deflection played a negligible part in its effect on the behavior of the floor, and that the continuity of the floor itself was the dominant feature.

Crossframe Action.—Two sets of observations, out of a large number, on the behavior of the crossframe (floorbeam, posts and bracket gussets) are reproduced in Fig. 5, together with a location diagram. They refer to the mid-span frame (*V*). The influence diagram of stresses in the posts and brackets at track level (point 114) shows very pronounced bending in the post, of reversed direction, as the load moves along the span. While the major bending is that in the plane of the floorbeam, with pronounced tensile stress along the inner edge of the bracket plate when the frame in question is loaded, there is also a decided bending in the longitudinal direction, reversing as the load passes the crossframe.

Slope measurements by clinometer made at the top and at two points near the base of the crossframe, as indicated in the location diagram, bring out the influence of the lateral deflecting tendency of the top chord upon the crossframe action. The slopes near the base of the frame are very regular, and quite in accord with the floorbeam bending as shown in Fig. 4; the slope at the top, however, decreases as the load comes on the floorbeam of the crossframe in question, evidently due to an outward pressure exerted by the top chord tending to resist the distortion of the crossframe. Apparently this action accounts for the tensile stress developed at the inner edge of the bracket plate, shown in the stress diagram.

Chord Stresses.—While the chord-stress measurements show diagrams that in general check closely with what would be expected, a number of interesting anomalies appear.

In the case of the bottom chord, decided differences in the behavior of the corresponding members of the two opposite trusses are found in certain cases. The end panel presents such a case, as shown by the curves for point 50 in Fig. 6. While the mean tension is pretty much the same for both chords, the chord of the left truss has two pronounced irregularities, one being an abnormal excess of stress when the load is near the first panel point, and the other a very decided upward bending of the chord, shown by high tension in the upper edge of the chord web-plate, which persists for all positions of the moving load. The former effect may arise from irregularities of tie bearing, but the other, lying in the truss itself, is possibly due to a kink in the member which tends to straighten out under tension. Near mid-span the bottom chord appears to behave more normally, with slight downward bending as might be expected to result from the general deflection of the span. There is little lateral bending shown either here or in the end panel, each of the measuring points being at the center of a panel.

Top Chord Irregularities

Much greater irregularities appear in the top-chord stresses, Fig. 7. At point 2, the extensometer at the bottom edge of the chord web was located over a web splice, and here a highly abnormal compressive stress appears. There is obvious lateral bending, the member bending inward presumably by the effect of the crossframe distortion, though the maximum does not occur until the load reaches the first panel-point. At mid-panel, point 3, the lateral bending is even more pronounced. However, the greatest lateral bending (compare points 36, 37 and 38) occurs at a panel point (38), where it approximately doubles the extreme-fiber compression. At the quarter point and middle of the panel (37 and 36) the lateral bending amounts to only about 50 per cent increase of the mean stress. The general downward bending of the span is indicated by the deficiency in stress at the bottom edge of the web at 36, and a pronounced secondary-stress effect possibly representing the shear deflection in the loaded panels is revealed by the downward bending appearing at 37. These curves are typical of the others obtained from the top-chord measurements.

Diagonals.—The double web system makes the diagonal stress measurements of peculiar interest. As the compression and counter diagonals are stiff and the tension diagonals flexible (two flats), unequal distribution of stress between the two systems might be expected. From the measurements plotted in Fig. 8 it appears that any differences of this sort are much smaller than the differences between inner and outer bar of a member and the bending and twisting stresses in

the channels of the compression diagonals. However, after elimination of these, by taking mean stresses computed for the center of gravity of the member, as is done in the two lower diagrams, it appears that the tension diagonals take considerably higher stresses than the compression diagonals in the end panels, and somewhat higher stresses even in the center panels, where the same section is used (two T's, 4½ x 2½ x ⅝ in.).

Lateral Bending of Top Chord.—The preceding curves are influence lines. Bending of the top chord is shown in a more readily intelligible way by the geometric plots, Figs. 9 and 10. Fig. 9 is for vertical load, Fig. 10 for horizontal load. For the former the lateral deflections are plotted, so that the curves represent the actual shape of the chord (in plan view) to greatly exaggerated scale. As in each of the four curves only one point is loaded, the chord deflection is controlled by the crossframe action. With load at mid-panel, the lateral ordinate of the top chord is greatest at mid-panel, though the deflecting force is applied through the frame at the panel point. The curves show a remarkably perfect degree of elastic action in the top chord, and give complete assurance that the top-chord action and stress distribution with respect to lateral bending proceed strictly in accordance with elastic hypotheses. In fact, the lateral continuity of the chord is great enough to cause the chord to pull the crossframes at some distance from the loaded region outward from normal position.

More complete proof of this latter point is furnished by the slopes of the posts (for half the span) under horizontal load. Fig. 10 plots the curve for a load of 4,400 lb. lateral pull on the top chord at mid-span. In this case the only vertical action exerted is that due to the reactions resulting from the elastic continuity of the floor which is bent down at the frame where the transverse pull is applied, by the downward bending of the floorbeam. If this action, however, were controlling in the transmission of top chord deflections, the greater slopes at the points of outward bending would occur in the lower portion of the posts, whereas the diagram shows that the slope at top of post is greatest throughout the span.

Conclusions

Analysis of Results.—Exhaustive analysis of the results of the measurements by comparing them with theoretical calculations yielded some noteworthy results.

The twisting tendency of the stringers, due to the outward thrust of the lower fibers of the tie and the concentration of tie load on the inner flange, was small, the two effects almost balancing. The maximum eccentricity of tie load (inward) was found to be less than ½ inch. Study of the stringer continuity indicated that slackness of the connections to the floorbeams reduced by one-half the negative moment at the ends of the panel, even after allowing for yielding of supports.

Reduction of stringer moment below the simple-span moment, mainly by continuity and only in very minor degree by rail distribution, averaged about 12½ per cent at mid-span and 31 per cent at one-sixth the span from the support; but as side thrust and torsion effects increased the extreme-fiber stress from vertical bending alone by amounts of 28 to 49 per cent, it was concluded that it is justifiable to neglect the continuity as compensation for the neglect of thrust and eccentricity of loading. The end shear was found to be slightly reduced (by ¼ to ⅓). The results were interpreted as indicating that if full continuity be counted on, the stringer connections should be detailed accordingly, to be capable of carrying a negative moment of 38 per cent of the center moment and an end shear three-fourths that of a simple span; while if only partial continuity is to be taken into account, as with ordinary detailing, a negative moment only half as great, or 19 per cent, and a shear on the floorbeam rivets of two-thirds the simple-span shear is to be counted. The floorbeam rivets are subjected to a moment which is at least equal to the stringer end shear multiplied by the distance from connection rivets to floorbeam web.

Floorbeam concentrations were found to be considerably reduced by the continuity. For load directly over the floorbeam, the concentration appeared to average about three-fourths of the axle load, about 13 per cent going to each adjacent floorbeam, while slight upward reactions appeared at the next two floorbeams. Other effects, however, increased the floorbeam stress to that corresponding to about 86 per cent of the actual load. The analysis of crossframe action was interpreted as indicating that the resistance of the bottom chord and of the laterals has little effect on the behavior of the frame. The end constraint of the floorbeams, according to the test, was relatively small.

Comparison of the truss stresses with those obtained by three methods of calculation—shear divided equally between tension and compression diagonals, shear divided in proportion to area, and precise calculation according to relative deflections—indicated that all three are fairly applicable, the variations of measurements equaling or exceeding the differences between the several methods. The bottom-chord stresses are uniformly less than the calculated ones, doubtless due to the chord action of the bottom lateral system and the stringers.

Floorbeam bending by the differential movement of stringers and bottom chord is broadly in agreement with what would be expected, but on analysis was found to be so greatly affected by the attachment of the laterals to alternate floorbeams as to make any numerical comparison impossible. The stresses in the laterals caused by vertical loading were found in agreement with the amount computed from the bottom-chord elongation, in that part of the influence lines (Fig. 3) which is of normal form; the increased lateral stresses in the loaded panels appear to be attributable to the spreading effect of the floorbeam bottom flange elongation. The greatest percentage of the chord stress carried by the lateral system amounted to 6½ per cent, but the large percentages occurred in the end panels, where the stresses were small in amount. The percentage of stress that went through the chord itself increased with the amount of the theoretical stress; a maximum of 93.6 per cent.

Under horizontal loading the measured floorbeam moments were found to be 10 to 20 per cent less than the calculated, due to the rigidity of the attached members of the floor system.

A few tests made with combined vertical and horizontal loading (but not with loads at the same panel point, as the horizontal straining device interfered with the vertical-load truck) resulted in showing that the measured stresses correspond to the sum of the separate stresses due to vertical and horizontal loading, with slight excess of the measured values under combined loading. This effect is charged to the reduction of restraints that have a relieving effect when only one form of loading is applied.

The Railroads—Not Entities But A National System

Abstract of an Address Given by Joseph B. Eastman Before the National Association of Railway and Utility Commissioners

THAT the railroads of the United States might be grouped some day in a "national transportation system which will be based upon a modification and development of the principle underlying public ownership and operation" is the belief of Joseph B. Eastman, a member of the Interstate Commerce Commission, as expressed recently in an address before the National Association of Railway and Utility Commissioners at Atlanta, Ga. Mr. Eastman said that he believed he could detect symptoms favorable to such a belief in the plan which has already been adopted in the case of the Boston Elevated Railway Co. and in the plan recently devised and now under consideration in the case of the transit companies of the city of New York. Both of these plans is held up as worthy of intensive study.

"I have no interest whatever in public ownership or operation for its own sake and I think I understand its dangers," said Mr. Eastman. "On the other hand it offers certain advantages which probably cannot be obtained to the same degree in any other way. I have in mind, among others, its advantages in the procurement of capital, in the protection of investors, in the co-ordination of facilities, and in the opportunity which it affords for management less hampered by the time and energy-consuming processes of an exacting system of public regulation. My only suggestion for the present is that these advantages ought not to be passed by because of prejudice, and that they offer, instead, an opportunity for genuinely constructive thought and statesmanship. An inventor having progressed thus far in the creation of a new machine would not rest from his toil until he had found the means of securing the advantages and eliminating the dangers. So long as the Interstate Commerce Commission and the Railroad Labor Board have their present powers, the opportunity for private initiative in railroad operation is circumscribed."

It was the statement of Mr. Eastman that any intelligent discussion of the railroad question should start with the premise that transportation "is an industry affected with a public interest which cannot safely be left to the mercies of unrestrained private initiative." That being the case, the problem is resolved into a critical examination of the present system with a view to remedying its defects.

Influence of Transportation Act

Mr. Eastman applauded the fact that the Transportation Act of 1920, if it had done nothing else, had given a "clear recognition of the principle that railroad companies are not to be regarded as separate entities, but as parts of a national transportation system which must be maintained, root and branch, in health and full vigor for the good of the country as a whole." He also pleaded for a full measure of co-operation (1) between transportation agencies the country over with the Interstate Commerce Commission; (2) between local transportation systems for the adjustment of local difficulties, and recommendations for the establishment of equable state and interstate rates; (3) between railroad management and railroad labor. Mr. Eastman saw "tremendous possibilities" in the development of the national transportation system which would include reconstruction and the joint use of terminal facilities. Great possibilities he also saw for the railroads in electrification, the economical production and use of power, the development of waterways and motor transport and their relation to and co-ordination with rail systems, and the possibilities which go with the phrase "economy and efficiency in management and concentration upon the details of operation."

Fundamental Policy

The fundamental policy, if there be any at all, which should govern and make it possible for state railroad commissions and the Interstate Commerce Commission to work harmoniously and efficiently Mr. Eastman asserted to be a realization of the principle that individual railroads cannot, any more than individual social or political groups, pursue an unrestricted course, but must be harmonized by restrictive measures which are national in their application. However, he asserted it was just as vital that smaller units be permitted to do the things for which they were best fitted for "otherwise the central organization becomes a formless and unwieldly thing gradually developing into a 'bureaucracy' dealing in an arbitrary and soulless way with all manner of little matters with which it cannot be in touch, and losing in the process all its larger vision."

"As I have said," continued Mr. Eastman, "the Transportation Act of 1920 has helped us to realize that there is such a thing as a national transportation system, and it follows that it must be guided in many respects by a national policy if friction and interference be avoided. Take the matter of railroad rates. I feel confident that you will all agree that a sound, national policy calls for harmony between state and interstate rates, and I use the word harmony in no rigid sense."

Chances for Co-operation

The chance for co-operation between state railroad commissions and the Interstate Commerce Commission Mr. Eastman believes lies in the ability of state railroad commissions to adjust their local differences and initiate programs for harmonizing state and interstate rates without waiting until the issue is thrust upon such local organizations. He asserted that he believed if the state commissions of the South would become the active proponents of a plan for bringing about harmony in rates within their territory they would stand on stronger ground than if the issue were brought to the front upon complaint of the carriers or upon the initiative of the Interstate Commerce Commission.

Other opportunities which seem to be afforded for co-operation between the federal commission and the state commissions include, he said, jurisdiction over construction of new lines and the abandonment of old lines. Such cases, he asserted to be difficult of decision from Washington, but the full co-operation of local transportation agencies was necessary in shaping the decisions.

Above all, Mr. Eastman said, there must be co-operation between management and employees for no "railroad can operate efficiently with labor which is either disloyal or disheartened." When wage reductions were considered Mr. Eastman asserted that labor was entitled to a seat at the council table and also to the presumption that it has no less "interest in the country's welfare

and no greater degree of selfishness than shippers or captains of industry." He further suggested that no scale of wages could be fairly or profitably built upon the "pay which men out of work in a period of unemployment are willing to take as an alternative to starvation."

Aside from the foregoing points in his discussion, Mr. Eastman asserted that in any discussion of the railroad problem sincerity, good will, ability to curb prejudices, ability to face facts squarely and follow them wherever they may lead, were essential.

No Excess of Unusually Heavy Rains During Current Year

Weather Bureau statistics do not show any important excess of unusually heavy rains during 1921 over such occurrences in previous years, according to information received from C. F. Marvin, chief of the Bureau. This is true in spite of the fact that a number of destructive floods have occurred during the year, and that a new high record for 24-hr. rainfall was made at Taylor, Tex., on Sept. 10, in the storm which produced the San Antonio flood, the total reached being 23.00 in. in 24 hr. Mr. Marvin tabulates as below the number of times precipitation in excess of 5 in. and 10 in. respectively in 24 hr. was recorded over the entire United States during the five summer months (April to August) of 1916 to 1921, inclusive. He says:

An examination of these tables shows no important excess of unusually heavy rains during 1921 over such occurrences in previous years; in fact, some of the years, notably 1916, show distinctly larger numbers of these occurrences than the present year. Neither does it appear that heavy local storms are necessarily associated with heavy annual precipitations, further than to augment the total accordingly. In fact, considering the two years 1916 and 1917, the former having the greatest number of heavy storms distributed through all the months and the latter the least of the years considered likewise through all the months, it appears that the former (1916) had really a less total rain during the five months considered than 1917, despite the lack of any larger number of heavy rains during the latter year.

However, in July, 1916, more than 22 in. fell at a point in western North Carolina in a similar period of time, and in June, 1886, more than 21 in. occurred at a point in Louisiana. The flood at Pueblo, Colo., in the early days of June, was not so much the result of unusually heavy rains, as to their occurrence in a region where the topographic conditions favored a quick and enormous run-off. Loss of life in these two floods was due to the fact tnat they occurred during the night.

NUMBER OF CASES OF EXCESSIVE PRECIPITATION IN U. S.

Precipitation in Excess of 5 Inches in 24 Hours

	April	May	June	July	August	Total
1916	2	21	14	99	15	149
1917	3	0	10	4	5	22
1918	10	12	5	3	10	40
1919	6	7	19	23	32	87
1920	17	17	8	12	19	73
1921	21	3	23	12	5	64

Precipitation in Excess of 10 Inches in 24 Hours

	April	May	June	July	August	Total
1916	0	0	0	12	0	12
1917	0	0	0	0	0	0
1918	0	0	0	0	0	0
1919	0	0	0	2	1	3
1920	0	1	0	1	0	2
1921	1	0	3	0	0	4

Suggested Remedies to Make Sewage Plants Function

Weekly Reports, Competent Supervision and Explicit Directions as to Operation Believed Essentials Required

THE human factor involved in the operation of sewage-works in Iowa rather than the design or bacteria upon which the transformation of organic matter depends is responsible for such poor operation that the investment is now a waste of money. John H. Dunlap, professor of hydraulics and sanitary engineering, University of Iowa, made this statement Oct. 27 before the third Conference on the Operation of Iowa Sewage Treatment Plants. The three steps which he believes will do much to remedy the present deplorable state of affairs are as follows: (1) A provision for weekly reports; (2) operation under the charge of a competent sanitary engineer and (3) the preparation of a set of directions. His further statements are as follows:

To ascertain how far the human factor involved in the operation of sewage-works was performing its share of the work, a letter was sent to the sanitary engineer of the state board of health of every state, requesting an outline of the law, or of the rules, followed in the control of the operation of such plants. Judging from the 41 replies, apparently only 18 states are now requiring the submission and approval of plans for sewage-works by the state board of health. Only five states are requiring monthly reports: West Virginia, Michigan, Kansas, New Jersey and Ohio. Only one, New Jersey, is requiring licensed operators. The impression from reading these letters is that the general situation is very unsatisfactory. For instance, in the report of the Illinois department for the year ending June 30, 1920, the following statement occurs:

> Experience has shown that there is a strong tendency among municipalities to neglect the operation of sewage-works. It is a common, falacious idea that these works require little or no attention, and consequently, they are neglected until objectionable conditions prevail because of odors from the plant or because of stream pollution. Some sewage treatment plants have been so neglected that they have become permanently damaged and can be put back into operating condition only at considerable expense.

The situation in Connecticut is apparently much the same, as the following quotation from a letter from J. Frederick Jackson, director of the Bureau of Engineering, indicates:

> I am sorry to say that very few of our plants, excepting the old sand filters, are properly operated. We endeavor to regulate them by occasional inspections and advice, but this is not satisfactory.

The writer was recently called in to advise a city council as to what was the matter with its sewage-works. An inspection of the plant was made, which revealed the following facts.

The Imhoff tanks were being operated like septic tanks, with a heavy scum on the sedimentation chambers and with the slots filled with sludge. The attendant in charge of the plant stated that he had been ordered by the city council to let this scum accumulate, since the council thought that this was the proper thing for the tanks and that they could not operate properly without the scum. On taking soundings to determine the depth of sludge, it was found that the sludge was solid from the bottom of the beam forming the slots to the bottom of the tanks. Since no perforated pipes had been placed in the bottom of the tanks at the time of construction, it was impossible to apply water under pressure and agitate the sludge. Accordingly it could not be removed from the sludge pipes. Due to this fact, the sludge was not as well ripened as it ought to be and dried

with difficulty on the sludge bed. Furthermore, trouble was experienced with foaming from the gas vents. It was found later that the sludge capacity of the sludge digestion compartments was altogether too small for the population now connected to the sewers.

Two of the four sand filter beds were badly pooled notwithstanding the fact that 18 in. of sand had been added two months before to one of the filters, and at the same time 12 in. of sand to the other. The remaining two filters of the plant were flooded with sewage 6 to 8 in. in depth, and the sewage was flowing over one of the underdrain vents at the corner of one of the filters. The filters were greatly overloaded, since their combined capacity was intended to serve only 2,200 people, whereas 6,000 people were using the sewers. Furthermore, the past season has been an unusually wet one, and this particular sewer system admits large amounts of ground water and also some storm water run-off.

It will be observed that the trouble with this plant was the human factor, which in this instance was principally the city council of six members—five of whom took office this spring.

The way out of this inefficiency and waste capital consists of three steps, each of which, though perhaps difficult to take, is necessary if a suitable return is to be made upon the large investments now required in sewage-works.

The State Board of Health should require the operator of every sewage-works in the state to render a weekly report of daily operation. The form for such report can be printed upon one side of an ordinary postal card, and when filled out at the end of each week, mailed to the sanitary engineer of the State Board of Health. On the address side of the post card should be printed the address of the sanitary engineer of the State Board of Health, and then upon the left half of the front side can be printed certain directions as to what to record in each column.

It is believed that there are many advantages to be secured by requiring a weekly rather than a monthly report from Iowa plants. For instance, the report card for a week is small enough so that it may be carried in the pocket of the operator, and filled out on the job when the readings and tests are made. Furthermore, the weekly report will aid in securing daily visits to the plants, and prompt knowledge of neglect by the sanitary engineer of the State Board of Health.

While the suggested form does not go much into detail, it does contain sufficient facts to show the state sanitary engineer whether the plants are being operated properly. The facts called for are easily obtained. For instance, in Column 1, the number of hours during which sewage is bypassed on any given day, and the reason for it, should be given in order that the state sanitary engineer may know just how much use is being made of the plant. The writer recently visited an expensive plant at which the sewage had been bypassed for a year's time, due to complete neglect on the part of the city authorities. Only after a threatened lawsuit was the plant put back into operation, and then naturally at considerable expense.

The counter contemplated in columns 2 and 3, is one of the simple devices now on the market, sold at a cost of $5.

The depth of sludge in the tanks, columns 4 and 5, is an important matter, especially at this season of the year when it must be ascertained whether or not there is enough room in the sludge compartments for the winter's sludge. The tests for settling solids in the influent and effluent, columns 6 and 7, are simple to make. Imhoff conical settling glasses are used. The average removal of settling solids by Imhoff tanks, as shown by the settling glasses, is about 95 per cent.

The condition of the filters, column 8, is an important part of the report since, on the average, two-thirds of the organic matter in sewage is in solution, and, therefore, must be oxidized by the action of the filters. The test for stability of the effluent, column 9, is easily made. A sample of the effluent may be caught in a 4-oz. bottle, to which is added by an ordinary pipette the proper proportion of methylene blue. The number of days' retention of blue color, when the sample is kept at room temperature, is then noted. If the sample retains its blue color for four days, no nuisance will be caused by discharging it into an ordinary creek or ditch.

The test for stability of the mixed river water and sewage effluent, column 10, is important in case the landowners below the plant should sue the city for damages due to supposed putrescibility of the creek water caused by the addition of sewage. The test is made in a manner similar to that upon the effluent from the filters. Full directions for these tests should be given in a small pamphlet to be issued by the state board of health.

The second step in the process of placing the operation of treatment plants upon a more scientific basis would be the appointment of a competent sanitary engineer in charge of a plant whenever the weekly operation report, or whenever a personal inspection on the part of the state sanitary engineer shows that the plant is not being operated properly. It would not be necessary for the sanitary engineer to devote much time to a given plant. By having copies of the weekly reports sent directly to him as well as to the sanitary engineer of the State Board of Health, and by giving the necessary instructions to the local attendant, proper operation of the plant could be obtained at all seasons of the year.

The third step in securing better operation of Iowa plants would include the preparation of a set of general directions for the operation of the various parts of sewage-works of all types. These directions should contain drawings and photographs of the proper tools to be used in carrying out the directions.

(To be Printed on a Postcard)

WEEKLY OPERATION REPORT OF THE SEWAGE TREATMENT PLANT

At_____for the week ending_____Submitted by_____

	Sewage By-Passed	Counter		Tanks (Cameron or Imhoff)				Filters (Sand, Sprinkling or Contact)		Outlet into Creek (Name of River, Etc.)	Hours Spent at Plant
				Sludge		Settling Solids					
Days	Hours	Reading	Time	Depth	Removed	Inf.	Eff.	Condition	Effluent Stability	Stability	
	1	2	3	4	5	6	7	8	9	10	11
M.											
T.											
W.											
T.											
F.											
S.											

12. Remarks.....

WHAT TO RECORD (To be placed on the left half of the front side of the postal card.)

Col. No.

1. Length of time in hours sewage was bypassed. Under "remarks" state reason.
2. Reading of counter in siphon chamber.
3. Exact time at which reading is taken.
4. Measure depth of sludge in tanks at several points and record average depth.
5. Cubic foot of sludge run out, computed from dimensions of sludge bed.
6. Find c.c. of settling solids in 1-hr. from influent. See directions for tests.
7. Find c.c. of settling solids in 1-hr. from effluent. See directions for tests.
8. Condition as to surface mat, pooling, evenness of distribution of sewage, etc.
9. Number of days' retention of blue color. See directions for tests.
10. Collect sample about 100 ft. below outlet and record days' retention of blue color.
11. Record the number of hours spent in work at the plant.
12. Under remarks, state any work done not included in columns 1-11, such as removal of sludge from sludge bed, etc.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Guide for Health and Sanitary Surveys

PUBLIC HEALTH SURVEYS: What They Are; How to Make Them; How to Use Them—By Murray P. Horwood, M. S., Ph.D., Instructor, Department of Biology and Public Health, Massachusetts Institute of Technology. With a foreword by William T. Sedgwick and an Introduction by George C. Whipple. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Flexible; 4¼ x 7 in.; pp. 403; illustrated. $4.50.

Surveys are rapidly becoming a popular and practical means of ascertaining the status of almost every kind of activity to learn what changes are needed for the sake of increased efficiency and to present these needs as graphically as possible to those whose interest and support are required. An investigation and report on a water-works made by a consulting engineer or a like report in any other engineering field might appropriately be called a survey, but the term is not often so used. Survey is now coming to have a special meaning confined chiefly to extra-official investigations. That is, the survey is made by or at the instance of some individual, institution or association, not itself responsible for the activity or group or activities surveyed.

In the public health field these surveys have been taking so wide a range as to include not merely health departments but also such other departments as are carrying on work which seems to affect, even though remotely, the public health. Thus, in the volume before us, we find chapters on water supply; drainage, sewerage, and sewage disposal; collection and disposal of refuse; milk supply; inspection of restaurants, lunch rooms, food stores; housing; school sanitation and hygiene, and hospitals. Some of these, as the author himself points out, have relatively little relation to public health.

The suggestive and inspiring Foreword by the late Prof. Sedgwick, the Introduction by Prof. Whipple and the three opening chapters by Mr. Horwood deal with public health surveys in general, as also do chapters toward the end on the survey report, getting results from surveys, and the value of surveys in public health campaigns. There are also chapters taking up in some detail the organization and activities of health departments, tuberculosis surveys, vital statistics, and budgets. A large part of the volume is occupied with material designed to show what constitutes a satisfactory water supply, for instance, and long lists of questions for use in making the surveys in the many fields covered. The book closes with a bibliography and a subject index.

Of the usefulness of Mr. Horwood's guide or manual to those engaged in public health and sanitary surveys there is no doubt. The book will also be useful to any city department in the fields treated which wish to have always in progress what might be termed a perpetual survey of their own department. This, in fact, is the ideal plan—an ideal which should also be extended under the direction of some leading official of the city so as to include and correlate the results of surveys of all city departments and their reactions as well upon the people for whose service city governments exist.

How far American cities are from such an ideal plan as has just been mentioned is well illustrated by the mere fact that public health surveys have become so common of late and that it is deemed necessary to carry them into such minute detail in so many city departments. By this we do not mean to imply that a general health survey at regular intervals, like periodic auditing of municipal accounts, would not be desirable even in an ideally governed city. The point is that such surveys as are detailed in this volume are what we have already termed as extra-official; and, moreover, that when made they often disclose disgracefully shocking and almost criminal lack of municipal efficiency. Otherwise, the mass of detail called for by this volume would be in existence, for one purpose or another, in every city.

Useful as Mr. Horwood's book promises to be, its usefulness might have been quite materially increased by picturing at the outset more clearly than is done anywhere in the book what constitutes thoroughly efficient sanitary and public health work, department by department. There might also well have been a clear indication of the order in which the various city activities involved should be taken up in the public health survey for the sake of (1) getting as quickly as possible a preview of the entire situation and then (2) of accumulating supplementary material as rapidly as may be in just that order which will make each step in the survey easier and tell more than the one before it.

The book contains too little on relative values of sanitary and health protective work as measured in terms of reduced sickness and death rates. Of the hundreds of questions listed under the various elements of the survey, there are many, the answers to which have only the remotest relation to sickness and death rates, if any relation whatever. For instance, of what advantage, in connection with such a survey, is it to know how many miles of sewers of different sizes there are in a city? Many of these questions might be omitted with advantage, or, if not omitted, use might be made of symbols to indicate what best could be ignored where lack of time or of funds make it impossible to carry out the complete survey program. This begets another suggestion, which is that there might well have been presented at the very beginning of the book an outline of a public health survey, with its elements arranged in order of importance: a public health survey score card arranged by percentages from matters of greatest to least importance.

Another Government War Record

ACTIVITIES OF THE BUREAU OF YARDS AND DOCKS—Navy Department, World War, 1917-1918. Washington: The Department. Cloth; 6 x 9 in., pp. 522; illustrated.

Civil engineering work of the army during the war was done by two or three different branches. In the Navy, however, it was solely in charge of the long established Bureau of Yards and Docks, expanded far beyond any previous experience to meet the war emergency. This book is the record of what the bureau did, and not only gives an extraordinarily vivid view of what the navy had to do in the way of structures, but also forms a good compendium of harbor structures and shop details such as were necessary to care for the tremendous activity of the navy during the war.

The Railroads—An Economic Problem

THE AMERICAN RAILROAD PROBLEM. A Study in War and Reconstruction—By I. Leo Scharfman, Professor of Economics, University of Michigan. New York: The Century Co. Cloth; 5 x 8 in.; pp. 474; $3.

When an engineer reads an academic discussion of a great economic engineering problem, he is bound to feel that the author has overlooked adequate emphasis and detail development of vital engineering considerations, however able and thorough the discussion. So it is with this work. The book embodies a searching and learned economic analysis of the causes and the experience of Federal Control, the aftermath and the problems that must yet be faced. As such it is well worth the perusal of the thinking railroad engineer. The picture painted is not one of optimism, and renewed government operation—war government ownership—appears to be held out as a distinct possibility in consideration of the subject as a public problem.

From the public viewpoint, the author treats railroad transportation as a natural monopoly and is strong in his indictment of duplication of facilities. The terminal problem is only touched upon in the chapter Unification and Service, and many engineers may be surprised at the statement that shippers' abuse of reconsignment privileges even in normal times probably constituted the greatest single cause of terminal delays. Here, most engineers will feel that a great opportunity was lost, because of the opinion now held by some engineering authorities that complete unification of terminals bids fair to solve the problem without unification of systems. Again, engineers acquainted with recent and highly successful improvements in freight terminal practice and abandonment of antedeluvian methods, will not be quick to accept shippers' abuse of reconsignment privileges as the greatest cause of terminal delays. However, at this point of the discussion, the assumption is made that the Interstate Commerce Commission has no authority to force joint use and operation of terminals. As pointed out in another chapter of the book, the Transportation Act has vested the commission with mandatory powers to effect such joint use of terminals, while its authority to effect consolidations of systems is merely permissive. To engineers, it will therefore appear as a matter of expediency that the question of terminal betterment is worthy of first consideration.

As an economic discussion of the railroad problem, the book on the whole is so thorough that the engineer-reader may have some regret that it does not cover the national transportation problem, considered from the public viewpoint of proper administration and physical co-ordination of railroads, waterways and highways. However, such broader treatment might properly be adjudged outside the realm of purely economic discussion since it would involve features distinctly engineering in character.

A strong case is made for looking to intensive rather than extensive development of railroad plant to provide properly for future traffic demands—a most important aspect of the problem that deeply concerns the engineer. In addition to other elaborate statistical data, there is presented an analysis of the maintenance situation which has decided engineering interest.

The book brings its subject practically up to date and may be said to be a painstaking and learned economic discussion of our greatest after-war problem.

Fifteen Years of London Water Studies

RESULTS OF CHEMICAL AND BACTERIOLOGICAL EXAMINATIONS OF THE LONDON WATERS; Report for Year Ended March 31, 1921—By Sir Alexander Houston, Director of Water Examination, Metropolitan Water Board, London. P. S. King & Son. Paper; 8 x 13 in.; 12 diagrams. 15s.

Sir Alexander Houston has made his fifteenth annual report the occasion for presenting, in addition to the usual data and comment for the year, a concise summary of his annual and his several special research reports on London water. The summary has all the more value because it is topical rather than chronological.

The main topics covered in the report are chlorination, resistance-to-filtration experiments, the vitality of B. Coli, of the typhoid bacillus, and of the cholera vibrio in river water; tests for distinguishing the vibrio and harmless water microbes, together with comments on various related bacterial searches, including those for streptococci and Morgan (No. 1) bacillus in river water; effects of storage upon the quality of river water; prefiltration studies and experiments with small rapid or mechanical filters; the use of coagulants in relation to purification. The report also contains enteric (typhoid) fever, meteorological, bacterial and chemical statistics.

American chemists, bacteriologists and sanitary engineers in charge of the quality of water supplies would do well to secure and study this report which teems with stimulating suggestions on water research and the interpretation of analytical data.

The Art of Graphical Representation

GRAPHICAL METHODS FOR SCHOOLS, COLLEGES, STATISTICIANS, ENGINEERS AND EXECUTIVES—By William C. Marshall, M. E., C. E., Consulting Engineer; Formerly Professor of Machine Design, Sheffield Scientific School of Yale; Consulting Engineer, Federal Sugar Refining Co., etc.; Mem. A. S. M. E. and S. A. E. New York and London; McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 253; illustrated. $3.

The classes of users for which this book is intended are set forth by its subtitle and are made clearer yet by the Preface, where the author states that he has aimed to make the treatment in part mathematical but yet within the grasp of "anyone with a common school education, or higher." This aim seems to have been well attained.

After an introduction, the author describes various kinds of graphs and the making of diagrams. He then gives numerous applications. There follow chapters on Determination of Laws, Calculations, Nomography, and Mechanical Graphical Records. An extensive Bibliography contains (1) nearly thirty books and pamphlets and (2) many references to illustrative material in technical journals, society proceedings, handbooks, etc., topically presented under such heads as accounting, air, boilers, costs, gears, pipes, and so on through the alphabet.

The book deserves wide attention and close study by all who use or might well use graphical methods.

Sketch of Moncure Robinson Republished

The rarely available "Professional Biography of Moncure Robinson," by R. B. Osborne, is reprinted in the William and Mary College *Quarterly Historical Magazine* for October (Williamsburg, Va.; $1 a number). Mr. Robinson was born in Richmond, Va., in 1802; graduated from William and Mary College at sixteen years of age; and began his professional career immediately by serving as a voluntary unpaid assistant

on a topographical survey and line of levels from Richmond to the Ohio River, being made by the Board of Public Works of Virginia. Mr. Robinson soon became an advocate of railways rather than canals, although for a time engaged in the construction of both. After a notable career of railroad building, including the Philadelphia & Reading, Mr. Robinson retired from professional work in 1847 to engage "in making investments * * * in productive improvements, considering it would be of more financial advantage to him than a further continuance in his active professional duty for others"—according to his biographer. Mr. Robinson died in 1891. The editors of the *Quarterly* state that the only copy of the privately printed biography by Mr. Osborne (written in 1888 and published in 1889) they have been able to find is in the John Crerar Library, Chicago.

PUBLICATIONS RECEIVED

ACOUSTIC IMPEDANCE AND ITS MEASUREMENTS—By A. E. Kennelly and K. Kurokawa. Constribution from Electrical Engineering Research Division, Massachusetts Institute of Technology, Boston, Mass. Paper; 6 x 9 in.; pp. 42.

AMERICA AND THE BALANCE SHEET OF EUROPE—By John F. Bass, Author of "The Peace Tangle" and Harold G. Moulton, Author of "The Financial Organization of Society," etc. New York: The Ronald Press Company. Cloth; 5¼ x 8 in.; pp. 361. $3.

The purpose of this volume, its preface says, is: "first, to determine the economic and political status of Europe at the present time; second, to appraise the probable effects of the international settlements (including reparations) that have recently been made; and third, to suggest in broad outlines an international policy such as it is believed the situation demands."

ANNUAL REPORT OF THE SOUTH AUSTRALIAN RAILWAYS COMMISSIONER, 1920-21—Adelaide. The Commission. Paper; 8 x 13 in.; pp. 36; Map and charts.

CALCUL PRATIQUE DES POUTRES CONTINUES EN BETON ARME: En Tenant Compte de la Raideur des Colonnes par G. Magnel Répétiteur á l'Université de Gand Chef des Travaus au Laboratorie de Resistance des Matériaux. Publie avec le concours du Bureau Technique Vercoutre. Gand: Van Ryssel-berghe & Rombaut, Editeurs. Paper; 6 x 10 in.; pp. 60, with charts additional. 30 francs.

CANADA DEPARTMENT OF RAILWAYS AND CANALS: Annual Report, April 1, 1920, to March 31, 1921. Ottawa: The Department. Paper; 6 x 9 in.; pp. 204. 20c.

THE CITY PLAN OF HAMILTON, OHIO—Chamber of Commerce, 1920—By Harland Bartholomew, City Plan Engineer, St. Louis, Mo. Paper; 8 x 11 in.; pp. 66; illustrated.

A COURSE IN MECHANICAL DRAWING: For School Use and for Self-instruction, A Practical Treatise on the Art of Making Working Drawings, Lettering and Dimensioning—By Louis Rouillion, B. S., A. M., Director Mechanics Institute, New York City; Author of "Drafting of Cams," "Economics of Manual Training," etc. Fifteenth Edition, Revised and Enlarged. New York: The Norman W. Henley Publishing Co. Cloth; 8 x 6 in.; pp. 92; illustrated. $1.50.

DEPRECIATION: Its Treatment in Production—Washington, D. C.: Chamber of Commerce, Fabricated Production Department. Paper; 6 x 9 in.; pp. 23.

DEVELOPMENTS IN THE RAILWAY USES OF CONCRETE—By A. Charles Irwin. Bulletin 23, American Railway Engineering Association, Chicago, Ill. Paper; 6 x 9 in.; pp. 88; illustrated.

DIE KLASSISCHEN PROBLEME RED ANALYSIS DES UNENDLICHEN: Ein Lehr-Und Ubungsbusch Für Studierende Zur Einführung in Die Infinitesimalrechnung von Dr. Gerhard Kowalewski, O. Professor Der Reinen Methematik An Der Technischen Hochschule Zu Dresden. Zwiete Auflage Mit 109 Figuren im Text. Leipzig: Wilhelm Engelmann. Cloth; 6 x 9 in.; pp. 342. Paper, 70 marks; cloth, 95 marks.

DIE SAUGSTRAHLTURBINE von Dr. Hans Baudisch, Professor an der Staatsgewerbeschule in ersten Wiener Gemeindebezirke. Mit 37 Textfiguren und 16 Beispielen. Leipzig une Wien: Frans Deuticke. Paper; 7 x 10 in. 10 marks.

EFFECT OF HYDRATED LIME AND OTHER POWDERED ADMIXTURES IN CONCRETE—By Duff A Abrams, Professor in Charge of Structural Materials Research Laboratory, Lewis Institute, Chicago, Ill. Paper; 6 x 9 in.; pp. 74; illustrated.

THE ELECTRICAL HANDLING OF MATERIALS. A Manual in Four Volumes, on the Design, Construction and Application of Cranes, Conveyors, Hoists and Elevators—By H. H. Houghton, M. Inst. M. E., M. Inst. E. E. Vol. 1. Electrical Equipment. Cloth; 8½ x 10; pp 260; 231 figures in text. Vol. II. Structural Work. Cloth; 8½ x 10; pp. 292; folding plates and 358 figures in text. London: Benn Brothers, Ltd. 25s each volume.

THE ENGINEERING FOUNDATION OF UNITED ENGINEERING SOCIETY. Am. Soc. C. E., A. I. M. & M. E., Am. Soc. M. E., A. I. E. E. Annual Report for Sixth Year, ended Feb. 20, 1921. New York: Engineering Societies Building. Paper; 7 x 10 in.; pp. 32.

FIRE PREVENTION AND FIRE PROTECTION: As applied to Building Construction, A Handbook of Theory and Practice—By Joseph Kendall Freitag, B. S., C. E., author of "Architectural Engineering," "The Fireproofing of Steel Buildings." Assoc. M. Am. Soc. C. E. Second Edition, Revised. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Flexible Binding; 4½ x 7 in.; pp. 1038; illustrated. $5 postpaid. 30/net.

FIRE RESISTANCE OF CONCRETE AND REINFORCED CONCRETE—Red Books of British Fire Prevention Committee. Paper; 5 x 9 in.; 40 to 50 pp. each; tables and illustrations. London, England. His Majesty's Stationary Office. 2s. 6d. each.

No. 216: Cement Concrete Floors Composed of Concrete Slabs of Various Aggregates and Portland Cement.

No. 228: Cement Concrete Floors Composed of Thames Ballast Sand and Portland Cement.

Nos. 238, 246 and 248: Reinforced Concrete Slabs Composed of granite, various stones, burnt clay and stock brick.

A selected list of titles in continuation of those announced in this section, Aug. 18, 1921, p. 289.

FLOW OF WATER THROUGH 4, 6, 8 AND 10-IN. GALVANIZED SPIRAL RIVETED STEEL PIPE—By F. W. Greve, Associate Professor of Hydraulic Engineering, School of Civil Engineering, Purdue, Ind.: Engineering Experiment Station of Purdue University. Paper; 6 x 9 in.; pp. 32; illustrated. Some of the data in this bulletin were printed in *Engineering News-Record*, July 28, 1921, p. 159, in an article by Prof. Greve.

GOVERNOR OF THE PANAMA CANAL: Report for 1920-21—Balboa Heights, Canal Zone: Jay J. Morrow, Governor. Paper; 6 x 9 in.; pp. 117.

GRAPHICAL ANALYSIS: A Text Book on Graphic Statics—By William S. Wolfe, M. S., Head of Structural Department, Smith, Hinchman & Grylls. Formerly instructor in Architectural Engineering, University of Illinois. First Edition. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 274; illustrated. $4.

GRAPHICAL METHODS FOR SCHOOLS, COLLEGES, STATISTICIANS, ENGINEERS AND EXECUTIVES—By William C. Marshall, M. E., C. E., Consulting Engineer; Formerly Professor of Machine Design, Sheffield Scientific School of Yale; Consulting Engineer, Federal Sugar Refining Co., etc.; Mem. A. S. M. E. and S. A. E. New York and London: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 253; illustrated. $3.

HANDBUCH FUR EISENBETONBAU—Dritte Neubearbeitete Auflage, in Vierzehn Bänden. Herausgegeben von Dr. Ingenieur F. Emperger, Oberbaurat, Regierungsrat im Patentamt in Wien. Erster Band, Entwicklungsgeschichte, Versuche und Theorie Des Eisenbetons Bearbeitet von M. Foerster, O. Graf, M. Thullie, A. Kleinlogel, E. Richter, A. Berrer, J. Melan. Mit 1076 Textabbilduncen und 1 Tafel. Berlin: Wilhelm Ernst & Sohn. Paper; 7 x 10 in.; pp. 800; illustrated. Paper, 186 marks; bound, 207 marks.

Chief among the extensive changes from prior editions of Vol. I. is found in the chapters on test results. Beam, slab and column tests are reviewed, as also special tests on pieces subjected to stress and pedestals. Tests on archs, treated separately, include measurements of temperature effects. The first editions of the four volumes comprising the entire work were reviewed in *Engineering News* as follows: Vol. I., April 16, 1908; Vol. II., March 12, 1908; Vol. III., Part 1, May 9, 1907, and Part 2, Aug. 8, 1907.

THE HUMAN FACTOR IN BUSINESS—By B. Seebohm Rowntree, Author of "Poverty: A Study of Town Life," "How the Labourer Lives," "The Human Needs of Labour," etc. London. New York, Bombay, Calcutta and Madras: Longman, Green & Co. Cloth; 5 x 7½ in.; pp. 173. $2 net.

INDUSTRIAL FATIGUE AND EFFICIENCY—By H. M. Vernon, M. A., M. D., Investigator for the Industrial Fatigue Research Board; Late Fellow of Magdalen College, Oxford. London: George Routledge & Sons, Ltd. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 264. $5.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS. Report of Annual Conference, 1921. Chicago: A. M. Anderson, Secretary, 37 West Van Buren St. Paper; 8 x 11 in.; pp. 43; illustrated.

THE J. E. ALDRED LECTURES ON ENGINEERING PRACTICE 1920-1921—The Johns Hopkins University, School of Engineering. Baltimore, Md. Paper; 6 x 9 in.; pp. 285; illustrated.

Three lectures each on civil, mechanical and electrical engineering subjects, including "Subway Construction in New York City," by Robert Ridgway, Engineer, Subway Construction, New York City; "Municipal River Front Improvements," by George S. Webster, Chief Engineer, Bureau of Surveys, Philadelphia, Pa.; "Modern Methods of Gas Manufacture," by Col. Frederick H. Wagner, Bartlett-Hayward Co., Baltimore; and "Electricity Supply Systems in Large Cities," by Philip Torchio, Chief Electrical Engineer, New York Edison Co., New York City.

THE LAW OF ZONING—By Herbert S. Swan, Zoning Consultant; A Review of the Constitutionality of Zoning Regulations Which Control Buildings in Accordance with a General Plan of Municipal Development. Supplement to National Municipal Review, Oct., 1921. New York: The National Municipal League. Paper; 6 x 10 in.; pp. 17.

LEHRBUCH DES EISENHUTTENKUNDE: Verfasst Für Den Unterricht, Den Betrieb und Das Enterwerfen von Eisenhuttenlagen von Bernard Osann, Professor An Der Bergakademie In Clausthal Geheimer Bergrat. Zweiter Band: Erzeusung Und EigenSchaften Des Schmiedbaren Eisens Mit 651 Abbildungen Im Text Und 10 Tafeln. Leipzig: Wilhelm Engelmann. Cloth; 6 x 9 in.; pp. 794. Paper, 145 marks. Cloth, 175 marks.

LONDON OF THE FUTURE—By The London Society under the Editorship of Sir Aston Webb, K. C. V. O. New York: E. P. Dutton & Co. Cloth; 8 x 10 in.; pp. 286; illustrated. $15.

MAINE STATE HIGHWAY COMMISSION—Report for 1920. Augusta, Me.; The Commission. Paper; 6 x 9 in.; pp. 59.

MATHEMATICS OF ACCOUNTING AND FINANCE—By Seymour Walton, C. P. A., Dean of the Walton School of Commerce, Chicago, and H. A. Finney, C. P. A., Professor of Accounting, Northewestern University, Chicago. New York: The Ronald Press Co. Cloth; 6 x 9 in.; pp. 274. $4.

MOTOR TRUCK TRANSPORTATION: The Principles Governing Its Success—By F. Van Z. Lane, C. E., Lecturer on Motor Truck Transportation, New York University. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 153; illustrated. $2.

NEW JERSEY BOARD OF PUBLIC UTILITY COMMISSIONERS: Report for 1920. Trenton: The Commission. Cloth; 6 x 9 in.; pp. 121.

NEW YORK STATE BRIDGE AND TUNNEL COMMISSION: Report for 1921. Albany, N. Y.: The Commission. Cloth; 9 x 12 in.; pp. 220; illustrated.

Includes report of C. M. Holland, chief engineer, covering traffic studies, design of tunnels, discussion of alternative construction methods, ventilation problems and experimental investigations. There are appendices on cast-iron tunnel analyses, and tunnel gas investigations.

NOS USINES METALLURGIQUES DEVASTEES—(1914-1918). Monographies De Quelques Grandes Usines Métallurgiques Francaises Detruites Par Les Allemands. Rédigées Par Un Groupe D'Ingénieurs. Introduction par M. Léon Guillet, Professor De Métallurgie Au Conservatoire Des Arts & Métiers et A L'École Centrale Des Arts & Manufactures. Paris: Editions De La Revue De Métallurgie. Paper; 9 x 11 in.; pp. 231; illustrated. 25 francs.

Text and half tones are effectively used to show the destruction of metallurgical works by the German invaders of France. In some cases the views show the works before and after destruction; in others, as destroyed and as since rebuilt.

OPPORTUNITIES FOR STUDY AT AMERICAN GRADUATE SCHOOLS—By George F. Zook, Specialist in Higher Education, Bureau of Education and Samuel P. Capen, Director of the American Council on Education. Washington, D. C.: Department of the Interior. Paper; 6 x 9 in.; pp. 59. 5c. from Superintendent of Documents.

POPULATION OF INCORPORATED PLACES: Prepared under the supervision of William C. Hunt, Chief Statistician for Population. (Reprint of Tables 51 and 52, pages 178-331, Volume I Fourteenth Census Reports.) Table 51—Population of Incorporated Places, 1920, 1910 and 1900, and Population of Wards of Incorporated Places Having 5,000 Inhabitants or More, 1920. Table 52—Population of Cities and Other Incorporated Places Having n 1920, 2,500 Inhabitants or More. Arranged in Groups According to Population: 1920, 1910 and 1900. Washington, D. C.: Bureau of the Census. Paper; 9 x 11 in.; pp. 331. Complete copies of Vol. 1, $1.50 a copy, cloth bound, from Superintendent of Documents.

PRAKTISCHE WINKE ZUM STUDIUM DER STATIK UND ZUR ANWENDUNG IHRER DESEITZE—Ein Handbuch für Studierende und praktisch tätige Ingenieure von Robert Otzen, Geheimer Regierungs-Rat und Professor an der Technischen Hochschule zu Hannover. Dritte Auflage Mit 125 Textfiguren. Berlin und Weisbaden: C. W. Kreidel's Verlag. Paper; 6 x 9 in.; pp. 178.

PRELIMINARY NOTE ON THE PURIFICATION OF WATER BY ACTIVATED SILT—By Gilbert J. Fowler and R. R. Deo. *Journal* of the Indian Institute of Science, April, 1921. Paper; 7 x 10 in.; pp. 8. Bangalore, India: Department of Applied Chemistry, Indian Institute of Science. 6 annas.

An interesting and suggestive account of experiments on the removal of dissolved organic impurities from water by silt activation, suggested by the rapid oxidation of highly polluted heavily silt-laden Chinese and Indian rivers.

THE PREPARATION, TRANSPORTATION AND COMBUSTION OF POWDERED COAL—By John Blizard. Ottawa, Can.: Department of Mines. Paper.; 6 x 9 in.; pp. 131; illustrated.

PUBLIC HEALTH PROBLEMS IN MEXICO AND THEIR SOLUTION DURING THE LAST FIFTY YEARS: Contribution of the Mexican Department of Public Health to the Semi-Centennial Celebration of the American Public Health Association. City of Mexico: The Department. Paper; 6½ x 9; pp. 34; illustrated.

PUBLIC HEALTH SURVEYS: What They Are; How to Make Them; How to Use Them—By Murray P. Horwood, M. S., Ph. D., Instructor, Department of Biology and Public Health, Massachusetts Institute of Technology. With a foreword by William T. Sedgwick and an introduction by George C. Whipple. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Leather; 4½ x 7 in.; pp. 403; illustrated. $4.50.

RAILROAD VALUATION BY THE INTERSTATE COMMERCE COMMISSION—By Homer B. Vanderblue, Ph. D., Associate Professor of Transportation in Northwestern University. (Reprinted from the *Quarterly Journal of Economics*, Vol. XXXIV, Nov., 1919; Feb., 1920.) Cambridge, Mass.: Harvard University Press. Cloth; 5 x 8 in.; pp. 119.

RAILWAY SIGNALING—By Everett Edgar Kink, Member of the American Railway Association, Signal Section, Member of the American Railway Engineering Association, Associate Member of the American Society of Civil Engineers; Professor of Railway Civil Engineering in the University of Illinois. New York and London: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 371; illustrated. $4.

RAILWAY STATISTICS OF THE UNITED STATES OF AMERICA, 1920. Compared with the Official Reports for 1918 and Recent Statistics of Foreign Railways—Prepared by Slason Thompson, Bureau of Railway News and Statistics, Chicago, Ill. Paper; 5 x 8½ in.; pp. 147.

RANGE OF PRICES OF WATER-WORK MATERIALS—Compiled in the Office of Dabney H. Maury, Consulting Engineer, Monodnock Block, Chicago. Reprinted from *Engineering and Contracting*, Oct. 12, 1921. Paper; 8 x 11 in.; pp. 8.

Includes wrought iron and steel pipe, both black and galvanized, cast iron pipe, pig lead, structural shapes, reinforcing bars, portland cement, common brick, vitrified sewer pipe, and copper. The data are presented, in some cases, in both tabular and diagrammatic form. Many of the original figures are credited to *Engineering News* and *Engineering News-Record*.

SPECIAL LIBRARIES DIRECTORY—Edited by Dorsey W. Hyde, Jr., Washington: Special Libraries Association. Paper; 6 x 9 in.; pp. 123.

Contains annotated list of subjects and a directory by states and cities, the latter with names of librarians. Some 1300 librarians are included.

STATE PARKS—By Harold A. Caparn, Landscape Architect, New York City. An Account of the Widening Movement to Preserve for All the People Choice Bits of Nature with Scenic, Historical, Recreational and Educational Values. Supplement to *National Municipal Review*, November, 1921. New York: The National Municip. l League. Paper; 7 x 10 in.; pp. 17; illustrated.

A SUPERPOWER SYSTEM FOR THE REGION BETWEEN BOSTON AND WASHINGTON—By W. S. Murray and Others. Washington, D. C.: U. S. Geological Survey. Paper; 9 x 11 in.; pp. 261; diagrams and folding maps.

An abstract of this report appeared in *Engineering News-Record*, Nov. 10, p. 738.

TABLES ANNUELLES DE CONSTANTES ET DONNEES NUMERIQUES DE CHIMIE, DE PHYSIQUE ET DE TECHNOLOGIE: Publiées sous le patronage de l'Union de Chimie pure et appliquée par le Comité international nommé par le VII Congrès de Chimie appliquée (Londres, 2 juin 1919).—By Secretaire general Ch. Marie, Dr. es Sciences. Vol. IV. Annees 1913-1914-1915-1916. Première Partie. Paris: Gauthier-Villars et Cie. Cambridge: The Cambridge University Press. Chicago: University of Chicago Press. Cloth; 9 x 11 in.; pp. 626; Postpaid $13.65.

Publication of these Annual Tables of Constants and Numerical Data, compiled by an International Commission, has now been resumed after interruption by the war. Part I (as above) contains constants from "compressibility" to "electricity." It is expected that Part II, covering the remaining constants, will be ready sometime in 1922.

TECHNOLOGIC PAPERS OF THE BUREAU OF STANDARDS No. 198. Results of Some Tests of Manila Rope—By Ambrose H. Stang, Associate Physicist and Lory R. Strickenberg, Assistant Mechanical Engineer. Washington, D. C.: Paper; 7 x 10 in.; pp. 11. Free on application or 5c. from Superintendent of Documents.

TECHNOLOGIC PAPERS OF THE BUREAU OF STANDARDS: Department of Commerce, Washington. D. C. Paper; 7 x 10 in.

No. 201: Friction and Carrying Capacity of Ball and Roller Bearings—By H. L. Whittemore, Mechanical Engineer, and S. N. Petrenko, Assistant Mechanical Engineer. Pp. 34; illustrated. 10c. from Superintendent of Documents.

No. 113: Structure and Related Properties of Metals. Pp. 104; illustrated. 25c. from Superintendent of Documents.

No. 202: Results of a Survey of Elevator Interlocks and an Analysis of Elevator Accident Statistics—By C. E. Oakes, Electrical Engineer, and J. A. Dickinson, Mechanical Engineer. Pp 30. 5c. from Superintendent of Documents.

TESTS OF PHYSICAL AND ELECTRICAL PROPERTIES OF SLATE—By Merton O. Fuller, Assistant Professor of Civil Engineering Laboratory, Lehigh University. Bethlehem, Pa.: The Author. Paper; 6 x 9 in.; pp. 34; illustrated.

VERANSCHLAGEN VON EISENBETANBAUTEN—Grundlagen fur den Entwerf und fur die Kostenberechnung von Tief—und Hochbauten. Mit mehreren der Praxis entnommenen Beispielen von Prof. Dr.-Ing. A. Kleinlogel, Privatdozent an der Technischen Hochschule in Darmstadt. Mit 23 Abbildungen. Zweite neubearbeitete Auflage. Berlin: Wilhelm Ernst & Sohn. Paper; 6 x 9 in.; pp. 123. 33 marks.

THE VOLUTE IN ARCHITECTURE AND ARCHITECTURAL ENGINEERING—By Rexford Newcomb. Bulletin 121, Engineering Experiment Station, Urbana, Ill.: University of Illinois. Paper; 6 x 9 in.; pp. 85; illustrated. 45c; limited number of copies free.

YEARBOOK OF THE CITY MANAGERS' ASSOCIATION, 1921—Clarksburgh, W. Va., H. G. Otis, Secretary. Paper; 6 x 9 in.; pp. 246. 50c.

Besides reports from many cities having managers and the general and technical proceedings of the 1920 convention, this yearbook contains a list of manager cities revised to Aug. 15, 1921. The list gives the population of the city, whether the plan was adopted by ordinance or charter and when in effect; the name of the manager, when appointed, his salaries and the number of cities he has served as city manager.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are therefore, asked to make their letters short.

The Significance of Cleveland's Adoption of Proportional Representation

Sir—Your interesting editorial of Nov. 17 regarding the welcome news that Cleveland had adopted the city manager plan did not explain the great significance of proportional representation on which Cleveland is to base its new form of city government. May I add a few words on this point? For it offers much of interest to those who like to see sound principles respected in public affairs as well as in bridge design or railroad location.

Proportional representation ensures that no important group of like-minded voters will be without direct representation in the council, and each group will have representation of its own choice proportional in number to the size of the group. Such is the council which will appoint the city manager and direct the policies of Cleveland—a very different thing from the plan of cities like Dayton, where every member of the council may be unacceptable to nearly fifty per cent of the voters. By the Dayton plan the city is divided, it may be about equally, into the Ins and Outs. In Cleveland 85 to 95 per cent will constantly be the Ins. In this year's election, Cleveland followed the example not of Dayton but of its nearer neighbor, Ashtabula, and of Kalamazoo, Boulder, and Sacramento.

Proportional representation has long been advocated by sincere well-wishers of popular representative government. The fear that in spite of the actual simplicity of the voters' part, it would look too complicated to be acceptable to American voters has stood in its path. Sacramento and Cleveland show that this fear is groundless. It is already in use throughout Ireland, with the warm approval of Sinn Feiner and Unionist alike.

Proportional representation appeals widely (1) because it is so eminently fair; (2) it is so well suited to bring the ablest and most trusted leaders into public life; (3) it gives all minorities the best possible protection and an orderly and wholesome chance of carrying their point when their cause is just and ripe; and (4) all decisions rest finally and firmly with a genuine and informed majority. Incidently it does away with primaries—without retrogression.

And Sacramento and Cleveland have shown that the only important objection to it is fanciful, even in the case of large and varied population.

LEWIS JEROME JOHNSON,
Harvard University, Professor of Civil Engineering
Cambridge, Mass., Nov. 26.

Highway Efficiency and Weak Bridges

Sir—I have read with considerable interest your article "A Question of Highway Efficiency," p. 759 of your Nov. 10 issue. Having served a number of years in bridge building I have seen highway bridges of the good, bad, and indifferent classes, and the wonder is that more of them have not failed under the present-day traffic.

When we consider a bridge designed for the light and slow-moving loads of the past, carrying the heavy loads of today, which are on the bridge and off again in less time than it takes to write it, creating an enormous impact which has never been considered in the design, then it is evident that something is radically wrong in our present method of design.

We are evidently penalizing the purchasers by excess material, either by playing safe or through our ignorance of the actual coefficients of strength of the various materials used. The accepted theory of stresses in framed structures enables us to determine the stress in any member of a structure when we have a specific loading, but determining the stresses is generally the smallest part of the work, and the design of members to carry the stresses safely is often a tax on the ingenuity and experience of the engineer.

The writer recalls a highway swing span which the county was considering replacing and which he considered absolutely dangerous, yet the county engineer was permitting use of the bridge without restrictions; and when the writer saw a tank wagon drawn by three horses cross the bridge without collapse of the structure the question of unit stresses and factors of safety seemed paramount. This bridge, of Pratt truss design, had one of the main diagonals on the inside of the truss broken, and the county authorities had bent the broken rod through the truss to the outside so that traffic might not become entangled. The trusses had adjusted themselves to the new conditions, shearing rivets through battens and lacing bars of the chords and vertical posts, the chords themselves forgetting the "straight and narrow path" they were designed to hold and each member assuming a position of least work; yet the bridge was carrying traffic in spite of all theory to the contrary.

It would seem that the solution of eliminating all highway bridges which today are too light is replacement. But, as such a financial burden cannot be considered, the next step would be to reinforce all such structures and properly police our roads to control the maximum loads carried over them.

C. H. OSBORNE.
Baltimore, Nov. 14.

Using the Flow Table in Central Mixing for Concrete Roads

Sir—The article "Central Mixing for Concrete Roads" by C. S. Hill in the Oct. 20 issue of *Engineering News-Record* is especially interesting in view of the experimental work during the past few years in connection with the development of the "flow table."

It is apparent that the success of a central mixing plant is dependent upon the employment of a test which will accurately measure consistency and furnish a definite value for the tendency of segregate.

My experience with the flow table indicates that it furnishes a means of measuring consistency which is even more accurate than needed in the field and in the same operation a definite value can be obtained for the tendency to segregate. The jolting or bumping to which the mass of concrete is subjected on the table is very similar to that which occurs when the concrete is hauled over the road. The tendency to segregate on the table is even more pronounced since the mass is not confined laterally and there is nothing except the adhesion within the mass to prevent the large particles rolling out beyond the mortar line, or the mortar from spreading beyond the zone of the coarse aggregate, depending upon aggregate gradation, cement content and consistency.

From the beginning of the work with the flow table it was apparent that "workability" or tendency to segregate could be as accurately measured as "consistency." The behavior of different concretes is marked, depending upon the above mentioned factors of cement content, aggregate gradation, shape of aggregate, and consistency. Flowability is measured as the spread of the fine material in the mass, or the diameter of the mass within the mortar line. In some concretes, especially the drier or the leaner, large aggregate particles will be found beyond the mortar line. When excess water is present the mortar line will spread beyond the coarse aggregate mass. A definite value can be obtained for either of these conditions, which will serve as a measure of the tendency to segregate. Observation of condition after haulage will permit safe values to be established.

I believe that it is generally recognized by engineers who have had experience with both types of apparatus that the flow table is far more accurate than the slump test as a measure of consistency, but there appears to be the feeling that the flow table is not suited for field use. This feeling is quite similar to that directed toward any change or innovation in field practice which at first thought tends

to upset or modify established procedure. However, the added expense on any work of importance is too small to warrant consideration and no great amount of time or especial skill is required in carrying out the test. The results of the test are definite and conclusive and will result in adherence to established limits for consistency, a most important factor which is at present seldom specified. On road or building construction a few tests at the beginning of the work will furnish to everyone concerned with the production of concrete, from the superintendent down to the laborer who wheels and places, a definite idea of the extreme limits of consistency which will be permitted, and thereafter only occasional tests will be required as a check.

In the laboratory a little experience with the flow table permits the worker to attain any specified consistency at first trial and the flow table test serves merely to confirm his judgment, and we find that it is rarely necessary to adjust the water content and make a second test. It will be found in field work, that after a standard has been established with the table, few tests will be needed and the "consistency" factor can be as accurately controlled as that of proportioning, with little added effort.

I believe that a trial of the flow table in connection with the control of consistency and the measurement of tendency to segregate in the operation of central mixing plants will demonstrate its ability to fully meet the requirements which Mr. Hill has outlined as being necessary.

Saskatoon, Sask., Oct. 29. G. M. WILLIAMS,
Professor of Civil Engineering,
University of Saskatchewan.

Effect of Motor Truck Tires on Unfinished Road Subgrade

Sir—Relative to road damage caused by contractor's trucks when equipped with pneumatic or with cushion tires, I submit the following, based on recent experiments made in our laboratory.

We have noted a belief on the part of certain high commissioners to the effect that the pneumatic truck tire does not injure incompleted road surfaces so much as does the solid or cushion tire. We manufacture the three types of tire, but in order to determine which was the proper type to recommend as equipment on road contractor's vehicles, we have made exhaustive experiments relative to area of road contact.

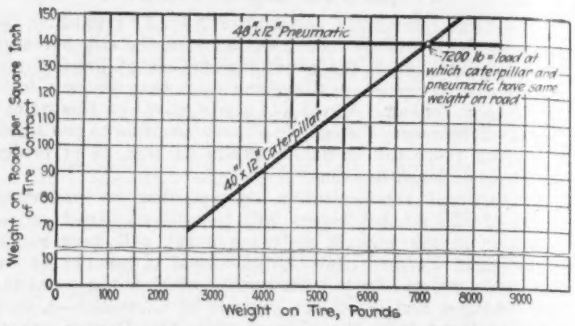
As we understand it, the damage created on the subgrade or incompleted road surface by tires is the "rutting" effect or tendency to make deep tracks in the soft ground. This is in reality a cutting action which is dependent upon the area of contact of the tire carrying the load, or rather upon the pressure of tire contact for each unit of contact area.

If we assume that the larger trucks are more efficient for highway construction work, we can consider the 5, 6, and 7½-ton sizes. The 6-ton truck will have a weight on each rear tire, when traveling empty, approximately 2,500 lb., and owing to the distribution of the load principally over the rear wheels, the weight carried by such rear tires when loaded will approximate 8,000 lb. or more.

If pneumatics are selected such a load would need to be carried on the largest tires yet produced and these have not as yet proved a commercial success. This size is the 48 x 12-in., which the manufacturers state must be kept inflated to a pressure of 140 lb. per sq.in. This is not only the pressure of the air within the tire but also represents the pressure upon the roadway for each square inch of tire area in contact with the surface. The peculiarity of a pneumatic tire is that this pressure per square inch of road contact is always the same whether the truck be loaded or empty and is dependent entirely upon the inflation pressure within that tire.

In the accompanying drawing the horizontal line indicates the pressure per square inch of road contact for the 48 x 12-in. tire under varying loads. This line is horizontal because the pressure does not change; the area of contact increases or decreases in proportion to the added or decreased load applied.

The 40 x 12-in. cushion tire, which will operate with considerably more resiliency than the solid tire and yet will retain practically all of the advantageous characteristics of the latter, will have a capacity of 10,000 lb., somewhat more than the 48 x 12-in. pneumatic. From our tests we have developed the relation between increase in road surface pressure per unit of contact area and increase in load carried by the tire. These results are indicated by the slanting line on the accompanying chart. From this it will be noted that when the truck is traveling empty with an approximate weight of 2,500 lb. on each rear wheel,



the caterpillar tire represents a pressure of but 68 lb. per sq.in. of road surface, whereas a pneumatic, under the same conditions, represents its constant 140 lb. As load is added to the caterpillar tire this pressure per square inch of road contact gradually increases until it equals the 140 lb. of the pneumatic when carrying a load of about 7,200 lb. or within 10% of the capacity of the pneumatic.

It will thus be seen that for all loads below 7,200 lb. the cushion tire-equipped truck represents more of a road-roller effect and less punishment to a soft road surface than does the pneumatic tire. For the final 10% of the maximum load, the pneumatic tire will have the advantage of a lower pressure per inch of road contact.

However, inasmuch as trucks of this size will not always be loaded to full capacity and will travel at least half of their distance with no load whatsoever except body and chassis, the average load will probably be in the neighborhood of 4,500 or 5,000 lb. on each wheel. Here the caterpillar tire represents a pressure of from 40 to 33 lb. less per inch of road contact than does the pneumatic.

We feel certain that this represents conclusive proof of the superiority of a properly designed cushion tire.

HAROLD W. SLAUSON,
New York City Engineering Service Manager,
Sept. 24. The Kelly-Springfield Tire Co.

Earth Roads Treated with Steam Ashes and Cold Asphaltic Oil

Sir—In *Engineering News-Record* of Sept. 22, p. 477, we described the practice and experience with earth roads treated in the summer of 1920 with steam ashes and cold asphaltic oil. In 1920 about 7,000 tons of cinders were used. So few of the roads required treatment after the winter of 1920-21 and the results were so satisfactory that we have already used this season (1921) 23,000 tons of cinders, corresponding to about 25 miles of roadway. The practice in 1921, as compared with that of 1920, has been simplified and shortened as described below:

The earth road is honed and shaped with a tractor and road machine. The cinders, spread by laborers with coal scoops to an average thickness of 4 to 6 in., are then slightly compacted by a short rolling with a 10-ton roller. Asphaltic oil is next applied from a gravity distributor at the rate of ½ to ¾ gal. per square yard and the roadway is given a final and thorough rolling with the 10-ton roller. The result is a firm smooth surface approaching the best macadam pavement in appearance and stability.

The total cost in 1920 was $0.27 per square yard and in 1921 $0.258, wages being the same in both years.

Office of President, Borough of Queens,
New York, Nov. 12.

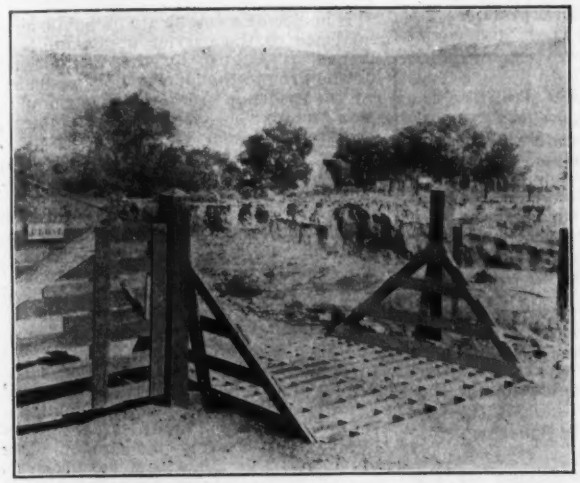
FRED. H. SHEPHEARD
AND
E. E. BUTTERFIELD.

HINTS FOR THE CONTRACTOR

Cattle Guard Saves Valuable Time on Truck Hauling Job

THE ROAD over which materials were delivered by motor truck to the Kern Canyon hydroelectric rroject in California passed through lands used for pasturing stock. Gates had to be kept closed, thus entailing truck delays which amounted to a serious inconvenience when materials were going in in large quantities. To avoid the necessity for stopping trucks at gates, cattle-guards, similar to those used on railways, were built as shown in the accompanying illustration.

The construction consisted chiefly of a series of transverse timbers or joists, 6 in. apart, with longitudinal



CATTLE GUARD ON A CONSTRUCTION JOB

headers between them on 18-in. centers. Each joist was made up of two 2 x 8-in. pieces, spiked together. By placing these guards beside the ordinary gates there was always the option of using guard or gate, the latter being sometimes preferable as in the case of very heavy truck loads, men on horseback, etc.

The use of cattle guards on this job is credited to R. C. Starr, construction engineer, San Joaquin Light & Power Corporation.

Cost of Steam Shovel Work in Building Logging Railroads

AS MORE modern methods come into vogue throughout the logging industry, equipment formerly used only in the more extensive operations is being employed by smaller companies to reduce unit costs or to speed up production. Some aspects of this situation were brought out in a paper by Minot Davis, Clemons Logging Co., Tacoma, Wash., read at the recent Pacific Logging Congress, in which there were detailed figures on the saving effected by this company in laying out their railroad construction and other excavation work so it would be economical to use a steam shovel.

Material encountered is largely in one of three classifications, namely, clay, loose rock or solid rock. The "loose rock" is a soft red or brown shale which is handled very rapidly after it has been loosened up with a few blasts. It stands on a very steep slope and is highly satisfactory material for handling with a steam shovel. The "hard rock" is a comparatively soft, blue sandstone which, nevertheless, requires fairly heavy shooting and has a tendency to break in large chunks. The average of these classifications has been 40 per cent clay, 40 per cent loose rock and 20 per cent solid rock. In the following discussion of comparative costs this average is assumed.

At the time the first shovel was bought the company was confronted with the necessity of building as quickly as possible 1¼ miles of railway which involved moving 60,000 cu.yd. of material. The contractors' bids were not less than $1 per yard, lumping all classes of material. However, by selecting the easier parts of the work contracts were finally awarded on an average of 72 cents per yard, the contracts being made directly with station men.

The greater part of the work was then done with a steam shovel. In six months the shovel had moved about 40,000 cu.yd. of material, at a cost after charging off all overhead, including depreciation, of $6,400 less than it would have totaled on the 72-cent station-man basis. The comparison is based on the theoretical amount of yardage as cross-sectioned and staked by the engineers. The steam shovel actually removed 10 to 15 per cent more material than the stakes called for, while the station men worked very close to theoretical quantities.

The company now operates two shovels, one having a ¾ and the other a ½-cu.yd. dipper. Both are of the revolving type mounted on caterpillar treads which is believed to be the only practical type for all-around construction such as is required in a logging operation. Both are equipped with a boom-hoist which is regarded as a necessity. The larger shovel weighs 30 tons and its rear end projects 11 ft. from the center bearing. The smaller shovel weighs 26 tons and has a rear projection of 9 ft.

While the larger shovel is more useful in handling solid rock which breaks in large chunks, it has to move more material in order to clear itself than does the light shovel, and this disadvantage is not believed to be offset by the larger capacity. Where the cuts will not be more than 15 ft. in depth and the road bed not more than 16 ft. wide, it is concluded that a light shovel is superior.

A good grade of mine-run steam coal is used for fuel. When the shovels are away from the railroad, the coal is delivered in sacks on a horse-drawn sled. Each shovel burns an average of one ton of coal per day.

Both shovels are kept in almost constant use. When not engaged in building railroad extensions they are employed in grading camp sites, landings and donkey settings and are frequently used in grubbing or "chunking-out" which they can do on steep and broken ground where it would be almost impossible to do this with a donkey engine. In order to handle this work to good advantage, one of the shovels has an auxiliary drum whence a cable passes through a small block hung on one side of the boom. With this it is possible to "chunk-out" as much as 200 or 300 ft. from the shovel.

From Jan. 1 to Aug. 10 this year the two shovels graded 2.99 miles of railway, moving 67,000 cu.yd. of material. The total cost of this work was as follows:

Labor, including industrial insurance	$17,200
Repairs, tools and materials	5,000
Coal	2,300
Powder, caps and fuse	1,500
Depreciation of equipment	1,400
Camp maintenance and cook-house loss	2,100
Engineering work	1,800
	$31,300

This averages 47 cents per cubic yard. If this could have been contracted for 30, 60 and 100 cents per cubic yard for the three classes of materials, which is doubtful, the average cost per yard would have been 56 cents, or a balance of 9 cents per yard in favor of the shovels.

NEWS OF THE WEEK

New York, December 15, 1921

Highway Officials Want Continuity in Federal Aid

Interlocking State and Federal Problems Discussed at Omaha Meeting—Committee Work Extensive—Manual Projected

Nearly every phase of highway development, finance, design, construction and operation was touched upon Dec. 5, 6, 7, and 8 at the annual meeting in Omaha of the American Association of Highway Officials. Only ten assigned subjects were scheduled, but practically every topic was handled by at least two men and sufficient time was therefore available for discussion, which was entered into freely. Location economics was probably the feature subject. Research co-ordination, future traffic, safety, aesthetics in design and maintenance administration were treated exhaustively. Projected federal-aid policies and graphic descriptions of the daily curling or warping of concrete under temperature and moisture changes elicited spirited discussion.

Reports of committees indicated that the organization is approaching one of its most valuable services, that of close comparison and broad standardization. Not much progress has been made yet beyond the first step, that of the collection of data as to standards in the various states. The aim of the bridge committee is eventually to produce a manual of recommended practice. The committee on tests has divided the country into nine districts where similar conditions will make similar specification limits possible, but it hopes to make methods of determining those limits universal.

Administrative Problems

Location Economics — C. J. Bennett, state highway commissioner of Connecticut, in his treatment of location economics, held that practically every case was special and that few rules were generally applicable. One of the fundamentals, he said, is to spend only an amount from which the public can get an adequate return. Final locations may not be possible for years.

F. F. Rogers, commissioner, Michigan, in discussion, referred to tests in Iowa by Prof. T. R. Agg, which indicated that for motor vehicles a rolling grade is more economical of gas than unbroken grades because of wind retardation at the higher speeds attained in descending the longer grades.

Frank T. Sheets, superintendent of highways, Illinois, stated that officials should hold vigorously to the proper location. On 85 per cent of 3,000 miles of interurban roads in Illinois there was no justification for running around all section corners. In a relocation of portions of the Chicago—Springfield line a saving of 40 miles is affected by an air line paralleling a railroad. With an estimated 3,000 vehicles daily, at 10c. per mile, the savings are enormous. R. J. Windrow, state highway engineer, Texas, said he considered proper location the greatest problem, since locations made now are probably final. He mentioned moving 142 hours in 136 miles. In 6 miles between Ft. Worth and Dallas a relocated road eliminated 7 grade crossings.

(Continued on p. 1000)

Name Bridge for Engineer

The Minneapolis City Council has named the concrete bridge over the Mississippi River at Franklin Avenue, now under construction, the "Cappelen Memorial Bridge" in tribute to F. W. Cappelen, former city engineer, who died recently. The structure will cost in excess of $1,000,000.

Alabama to Vote Again on $25,000,000 Road Bonds

Gov. Thomas E. Kilby of Alabama has issued a proclamation calling for a special election on Jan. 30, 1922 to vote on a $25,000,000 highway bond issue. If this bond issue passes, roads will be built by the State Highway Department connecting every county seat in the state. Not less than $250,000 plus federal aid will be spent in each county on state trunk roads and bridges.

Little doubt is expressed as to the passage of this bill. The original bill which was declared unconstitutional passed the people by approximately a 7 to 1 vote. Since its annulment about 10 counties have voted for bond issues, the money to be turned over to the state highway department. All of these elections went in favor of the bond issues by votes ranging for 2 to 1 to 10 to 1.

Chicago Opens Large Double-Deck Bascule Bridge

The 268-ft. double-deck double-leaf bascule bridge over the Chicago River at Wells St. was put in service for the elevated railway on Dec. 4, railway traffic having been continued over the old swing bridge until the evening of Dec. 2. Under the original program, outlined in *Engineering News-Record* of Sept. 13, p. 606, this traffic was to be stopped from Saturday morning to Monday morning, but in view of the heavy Monday morning traffic it was decided to advance the time and have the bridge ready on Sunday evening. With the old bridge swung to the open position and blocked up on the rest pier, it was cut apart by torches and the members of the middle portion removed by cranes, leaving a gap into which the leaves of the bascule were lowered. Owing to the grade of the bridge being above that of the old structure, necessitating street alterations at the south end, the lower or roadway deck is not open to traffic. It is expected the bridge and approaches will be completed by the end of the year.

Passenger Terminal for Cleveland Authorized

Interstate Commerce Commission Reverses Decision Made Public August 12

Reversing its decision made public Aug. 12, the Interstate Commerce Commission on Dec. 7 authorized the New York Central, the New York, Chicago and St. Louis and the Cleveland, Cincinnati, Chicago and St. Louis Railroads to acquire control of the Cleveland Union Terminals Co. and to construct and operate a terminal station for passenger trains in the Cleveland Public Square.

Issuance of a certificate of public convenience to the carrier applicants was denied in August by the Commission on the ground that it was not persuaded by the evidence presented that the plan was compatible with public interest or that sanction should be given it owing to the enormous expenditure involved. At the time the application was dismissed, however, the majority opinion held that "possible the presentation of further evidence or the modification of the plan in various particulars might make possible a different conclusion." No changes in the physical aspects of the plan have been made in the meantime, though some fiscal changes have been made.

In its opinion made public Dec. 7 the commission found that "It is conceded by all parties that the existing passenger terminal facilities are antiquated and entirely inadequate. The opinion further finds that "evidence as to congestion during times of normal as well as heavy traffic movement is persuasive that additional facilities are imperatively needed."

Advantage of New Project

The plan proposes an additional route through Cleveland for the through business of the applicant railroads and a separate and independent passenger route from Collinwood on the east to Berea on the west, with the complete segregation of passenger movement through the city, thus leaving the full capacity of the lake-front tracks and of the Cleveland Short Line available for freight movement only.

It was pointed out in the opinion that the original estimates of the cost of the project were made on the basis of 1920 prices and that these estimates as now shown by the applicants may be reduced by an average of about 20 per cent on account of the present lower cost of labor and materials.

In a dissenting opinion Commissioner Eastman finds that it is difficult "to reach the conclusion that the new passenger route of the Public Square plan will be any more effectual in the relief of railroad congestion than the eight main tracks through Cleveland and the elimination of present obstacles to the free movement of traffic which would result at much smaller expenditure of capital from the adoption of the Mall plan." (See *Engineering News-Record* Aug. 18, 1921, p. 297.)

Want Federal Aid Extended

According to the Secretary of War the agriculture bloc in the U. S. Senate has on its program legislation looking to the further extension of federal aid to so-called farm-to-market roads. Secretary Weeks sounds a note of warning against extending federal aid to highways entirely local in character.

Marshal Foch Honored by Engineering Societies

Membership in Civil, Mechanical, Electrical and Mining Bodies Conferred in New York

In the presence of an audience which filled to capacity the auditorium of the Engineering Societies' Building in New York City, honorary membership in the four national societies of civil, mechanical, electrical, and mining engineering was conferred upon Ferdinand Foch, Marshal of France, at a ceremony held Dec. 13, on the eve of his departure from the United States. This is the first time that any one man has held honorary membership in the four founder societies.

J. Vipond Davies, consulting engineer of New York City and president of the United Engineering Society, presided and introduced as the first speaker Col. William Barclay Parsons, who served during the war as commanding officer of the 11th Engineers in France. After a brief address in French, Col. Parsons introduced George S. Webster, president of the American Society of Civil Engineers, who conferred upon Marshal Foch certificates of honorary membership on behalf of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Institute of Mining and Metallurgical Engineers.

Mr. Webster, in making the presentation, said:

"Ferdinand Foch, Marshal of France, Commander in Chief of the victorious armies of the Allies, master of military strategy, foremost military engineer, the hope of the civilized world during the dark days of the War, idol of the exponents of liberty and justice, military genius whose effective coordination of the armies of the Allies and whose indomitable will inspired them with the hope and the renewed vigor which brought the World War to a successful close!

"In recognition of these achievements and of your unparalleled service to mankind, I have the honor on behalf of the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers, to present to you this certificate of honorary membership, signed by the president and secretary of each society, and also these emblems of membership in the societies."

In accepting honorary membership in the four national engineering societies, Marshall Foch said:

"It was due largely to the engineers and the engineering industries that the war was brought to a successful conclusion. The armies could not have accomplished much without the effort of the engineer. Success was made possible to a great extent by the industry of the people at home, but when decisive moments arrived the engineer stood out as an essential factor in attaining success.

"What would have become of the armies without the engineering industries and without the professional knowledge which you exercised and which enabled us to lead our armies in the field, to feed them, to protect them and to facilitate their forward moment?

"It is for these reasons that I am pleased to be here today, to receive so splendid a welcome, to express my gratitude and that of France and of all my countrymen for the splendid sacrifices made by the men of your calling. I am grateful to you for including me in your ranks as one of the members of your four national engineering societies. This honor I deeply appreciate, and I shall always cherish this event with the happiest memories."

Criticism of Joint Committee Report Heard in Two-Day Meeting

Main Objection to Concrete Specifications Against Strength Guarantee Clause—Some Design Provisions Attacked

On Dec. 7 and 8, in New York City, the American Society of Civil Engineers held a six-session meeting to discuss the Tentative Specifications for Concrete and Reinforced Concrete issued last June by the Joint Committee on Concrete and Reinforced Concrete. This is the first open meeting at which these specifications have been considered in pursuance of the program whereby each of the constituent societies could criticise and discuss the report for from six months to a year before referring it back to the committee for consideration in preparing a final specification. From 50 to 300 men were in attendance at the various sessions.

The scheme followed was to receive discussions of specific sections of the specifications at certain sessions, and to confine the discussions quite closely to the announced sections. It was made plain that the committee was present mainly to hear comment and not to defend the specifications. After some controversy early in the meeting, the chairman, Richard L. Humphrey, who is also chairman of the Joint Committee, stated that members of the committee present would be glad to explain anything in the specifications, but it proved that this meant in the main that they would clear up any obscure clauses and not that the reasons governing the writing of the clauses would be gone into. In the matter of column and flat slab design the basis for the specifications was freely stated; in some other instances, notably in the rail-steel bar discussion, the committee chose to stand on the report as printed without explanation.

Discuss Scope of Report

As a necessary piece of information in the conduct of its work, the committee sought light from those present as to the scope of the present report, whether it were better to confine it entirely to building or whether to include in complete form or by high spot references the other types of construction, such as bridges, dams, chimneys, reservoirs, etc., and whether it would be most useful in the form of a specification or as recommended practice. Those who discussed this inquiry were neither in accord nor apparently quite clear individually as to what this scope should be. It was admitted that it would be impossible to prepare specifications for all types of reinforced-concrete construction, but no one was able to lay down a strict line of demarcation by which only the basic principles would be treated, nor to offer constructive criticism of the present form except to point out, for instance, that in the table of stresses there was no provision made for a unit stress in a reinforced-concrete arch rib and to suggest that the specifications as written lean somewhat too heavily to buildings.

It was also contended that inasmuch as such failures, mainly in surface disintegration, as are occurring in concrete today are found in outdoor structures that there might well be a distinction between units in buildings as specified in the current specifications and the identical units in an outdoor structure subject to the vicissitudes of weather. Furthermore, there were certain of the speakers, governed apparently by their antagonism to certain specific clauses in the tentative specifications, who held that it is not proper rigidly to specify such things as are in this document, but they had better be put forward as recommended practice. It was admitted that this would allow much greater flexibility in the treatment of the subject, but that at the same time would make it difficult to delimit the extent of the report.

The major part of two of the sessions was given over to discussions led by commercial interests who felt that they had been militated against in the report. The first of these discussions was led

Would Prevent Turning Schoharie Into Catskill Aqueduct

A suit to enjoin the diversion of Schoharie Creek from the Mohawk River southward into the Ashokan reservoir of the Catskill aqueduct water supply of New York City, or for $1,000,000 damages if the diversion is not enjoined, has been brought by the Cohoes Power & Light Co. The company claims perpetual rights to the Mohawk flow in excess of what is needed for Erie Canal navigation.

Hearings on Polluting Navigable Waters by Oil and Acid

The House Committee on Rivers and Harbors was to begin hearings Dec. 7 on two bills (H.R. 7369 and 7430) designed to prohibit the discharge into navigable waters of any oil or oil wastes and on a third bill (H.R. 8783) covering acids and acid wastes in a like manner. One of the oil bills is new legislation, a simple prohibition, while the other amends Sec. 13 of the River and Harbor Act of March 3, 1889, with substantially the same intent as the first bill, but with more explicitness. The acid bill is also an amendment to the River and Harbor Act of 1889.

by the advocates of so-called integral waterproofing who opposed the clause "No integral waterproofing shall be used." Their contentions were mainly statements of theoretical action of such waterproofers and experience statements as to the use of the integral compounds with great success. It should be said, however, that those having such compounds to sell were backed up by several independent engineers who seemed to feel that they had been successful with integral waterproofing in the past and that it was unwise to forbid its use. No actual facts for or against integral waterproofing were advanced.

Commercial Interests Heard

The second commercial discussion waged around the reduction of the unit stress in rail-steel bars, which are credited in the specifications with 16,000 lb. as against 18,000 lb. for intermediate and hard grade billet steel bars. Here, too, the discussion was entirely ex parte.

The most serious opposition to the specifications was that voiced against the first two alternate clauses in Section 28, which specifies the proportions of the concrete. The second of these clauses certainly and the first in the opinion of some put full responsibility for the proportioning and mixing of the concrete on the contractor, the engineer merely specifying the strength to be reached in cylinder tests at the end of 28 days. Opinion from the floor was unanimous against this clause. It was contended to be unethical in that it relieved the engineer of his necessary and desired responsibility and unworkable in that it provided for the rejection of material which at the time its rejection was decided upon would be in most cases an integral part of a structure, irremovable without wrecking the structure or at least seriously damaging it. The inconsistency and unreliability of 28-day cylinder tests were pointed out and the possibility of manipulation of tests so as to still further increase such disparity prophesied. Generally it was contended that while the art of concrete had greatly progressed and that while specifying quality and strength was something which could possibly be hoped for, the present state of the art was not such that a strength could be absolutely guaranteed and that it was plainly the duty of the engineer to take the chances involved in attempting to produce a given strength.

It was suggested by a number of speakers that the clause could well be rewritten so that the engineer should specify a tentative proportion which he hoped would produce the greatest strength and on which the contractor would bid, at the same time bidding on additional units of cement and possibly of aggregate, so that the engineer could readily shift his proportions during construction provided the tests he himself made seemed to show that his assumed proportions were not up to his required strength. In defense of the clause, Prof. D. A. Abrams, of the committee stated that there was much misapprehension as to the clause, that it was not intended to harm the contractor as many of them seemed to think, but to give him the advantage of being able to produce an acceptable concrete at a lower cost. He said it would not necessarily require wrecking, because there are many ways of improving concrete after it has set by more curing, heating, etc. However, he thought if removal is necessary would it not be better to remove the structure than to have it fall down? He said that a great deal of current concrete is not satisfactory and that some way must be devised for producing better concrete. The committee felt that this might be one way in which this could be done.

Minor Details Criticized

There were a number of specific criticisms of minor details of design, some of which, it was admitted by members of the committee, were still a subject of discussion in the committee; others of which, it was pointed out, were in error or typographically incorrect. The main criticism of the design came from New York contractors who had made an analysis of a typical reinforced-concrete building designed under the provisions of the present New York code and of the proposed tentative specification. It was found that a flat-slab building of the assumed size and loading would cost about 11 per cent more under current prices by the specification than it would by the New York code and that a beam-and-girder building would cost for the lighter load around 5 per cent and about the same for extremely heavy loads (600 lb. per square foot). They asked the Joint Committee approximately the following question: How can we tell our clients who are successfully using buildings which we have built under the New York code or codes stricter than the New York code that the buildings which we will build them under the new specifications are worth from 10 to 15 per cent more than the ones which they now occupy? In other words, they asked for specific statement of the superiority of service to be gained by the stricter regulations of the tentative specifications. In reply members of the committee stated that in the first place the tentative specifications give higher unit stresses than the New York code in everything except columns, in which it is contended that the New York code is extraordinarily bold. Furthermore, they said that the added cost in the analysis submitted is due mainly to the extra expense of producing what the tentative specification calls a 2,000-lb. concrete, and in the opinion of the members who spoke the probabilities are that the so-called 2,000-lb. concrete that is being produced under the New York code is not 2,000-lb. concrete. In other words, the buildings required under the tentative specification would be stronger than the ones now being built in New York City.

Source of Column Formula

F. R. MacMillan, of the committee, explained the source of the column formula which is radically different from any other formula yet suggested for concrete columns. It is based on data published in the 1921 *Proceedings* of the American Concrete Institute, and takes into account the shrinkage of concrete during setting, the initial tension in steel introduced by this shrinkage, and the flow of concrete under load. The rational formula to meet these conditions was set forth in the A.C.I. paper noted. The formula in the specification is a simpler algebraic form practically duplicating the curve of the other formula, which explains its apparent lack of rationality. No contention was made by any of the speakers that the formula was wrong or that the other formulas were right. The entire contention was that this gave a more expensive column than the formulas which have apparently produced satisfactory columns.

Some opposition to the design provisions was expressed by Edward Godfrey, who contended that decreasing the mid-beam moment coefficient from $\frac{1}{12}$ to $\frac{1}{16}$ and at the same time increasing the unit stress from 650 lb. to 800 lb. was in effect increasing on a ratio of 39 to 64, which, in his opinion, was "an enormous degradation of design standards." Mr. Godfrey contended, furthermore, that we must not get away from the average concrete produced on the job and not attempt to specify fancy concrete according to laboratory method which could not be reached in the field. He was also not yet satisfied with the shear provisions of the specification which have been a point of attack by him for years.

Prof. Talbot's Views

Prof. A. N. Talbot stated that while he was not altogether prepared to accept the 800-lb. per square inch flexural stress noted, the use of that certainly deserved consideration and that the factor of safety was probably greater than the ratio of 2,000 to 800 lb. In the first place, he said, the stress-strain relation was not a straight line, but rather a parabola which increases the load carrying capacity of the beam and changes the factor of safety from about 2½ to about 3 or more. Also, when concrete is under compression in flexure the actual strain before failure is more than in direct compression, which adds to the factor of safety another 20 per cent, raising the total ratio up to about 3½ to 4. On the other hand, he said, when concrete is repeatedly stressed the actual point of failure may be lower than for a single application which reduces the ratio to about 3, or at least as great as the ratio between the 16,000 lb. of the steel and its 40,000 lb. elastic limit. He repeated, however, that it should be given earnest consideration whether this was enough. He felt, on the contrary, that the 900 lb. and the negative moment might be too high. In further discussion of this factor of safety the familiar fact was pointed out that in reality the factor of safety is much greater than the ratio between the unit stress and the compressive limit of the concrete, because the unit stress is arrived at by the action of both dead and live-load and the added load which can cause failure can only be a live-load, so that the ratio of the design live-load to the live-load which would cause failure is greater than the direct ratio of the safe compression and the breaking load of the concrete.

Very little discussion was devoted to the flat-slab specifications, about the only comment being that they appeared to require a more expensive structure than would be required under most of the current codes. Objection was registered to the footing design and it was admitted by members of the committee that they were by no means satisfied with these provisions.

Taken all in all, the criticisms seem to divide into two classes—those by engineers who opposed or were concerned about certain more or less minor details of design practice, and those by contractors who seemed to feel that the specifications tended greatly to add to the cost of concrete work without compensating improvements. The latter were greatly in the majority.

Paving Brick Manufacturers Take Important Action

Endorse Simplification of Varieties—To Promote Brick for Sewers and Bridges

Endorsement of the simplification of paving brick varieties recommended at the recent Department of Commerce Conference in Washington, D. C., the determination to promote the use of vitrified brick for sewer and bridge construction, and the approval of asphalt filler as the preferred type were the outstanding features of the annual conference of the National Paving Brick Manufacturers' Association which was held in Pittsburgh, Dec. 6 and 7. The reports of the board of directors, the secretary and the treasurer showed that the association was vigorously functioning and that the financial condition was sound. O. W. Renkert, president, presided at the meetings.

Much interest was shown in the variety elimination accomplished at Washington. The recommendations as to the elimination were unanimously approved and the new standard sizes will be included in the association's specifications. The creation of the standing committee on further elimination was approved, the association going on record as believing that further eliminations were desirable.

The determination to promote vitrified brick for sewer and bridge work as well as for pavements followed a report by Will P. Blair, vice-president, presenting the results of study of the successful use of brick in such structures.

Asphalt Filler Endorsed

The resolution endorsing asphalt filler as the preferred type set forth that the associations' studies had shown for some time a decided trend toward the use of asphalt filler, that 60 per cent of the brick pavements laid this year were so filled, and that it was clear that the majority of engineers and public officials were convinced that such filler insured the construction of durable and economical pavements. The association, however, in expressing its confidence in and preference for asphalt-filled brick pavements properly designed and built, did so with the qualification that its expression of preference was without prejudice to any other type which might possess peculiar adaption to special local conditions. The resolution covering this matter was recommended by an engineering committee composed of J. R. Marker, W. C. Perkins, R. H. MacKinley, Will P. Blair and M. B. Greenough.

Among the forward-looking activities provided for in the budget were appropriations for research and for devising a uniform cost-finding system. A promotional plan of much larger proportions than in former years was provided for, the whole budget being based on an estimate of the laying of 7,000,000 sq.yd. of brick pavement next year.

Addresses were made during the conference by A. V. Bleininger, chairman of the Joint Clay Products Research Committee, on "Research in Relation to Paving Brick Manufacture"; by E. J. Mehren, editor of *Engineering News-Record* on "The Engineering Viewpoint Toward the Trade Association"; by E. W. McCullough, of the U. S. Chamber of Commerce on "What Trade Associations are Doing for Their Members"; and by Prof. Arthur H. Blanchard, of the University of Michigan, on "Trade Associations and Their Relation to Educational Institutions." Special interest was shown in the progress of the clay products research to date and very evident approval of the work was registered not only by the subsequent vote of a continuance of appropriations but by the spirit shown and the questions following Prof. Bleininger's paper.

Mechanical Engineers Hold Annual Meeting

Professional Engineering Education and Waste Elimination Chief Discussions

Professional engineering education and the elimination of waste in industry were the chief topics for discussion at the forty-second annual meeting of the American Society of Mechanical Engineers held in New York City, Dec. 5-9. General topics of engineering interest were also discussed, among them being plans for the establishment of a world union of engineers, announced by Ambrose Swasey, of Cleveland. He pointed out that engineers and scientists are the determining factors in modern warfare and are constantly assuming an increasing importance in this field. A world association of such men would work, he thought, for a deeper mutual understanding in times of peace, and their association would tend to obviate international discord.

Engineering Education

In the discussion of professional engineering education the four speakers—F. C. Pratt, A. G. Christie, J. E. Otterson, and Prof. Dexter S. Kimball—brought out forcibly the need for (1) a well defined national system of engineering education; (2) avoidance of narrow, specialized training; (3) an opportunity for the technical mind to progress in a measure commensurate with its ability and not be checked by a curriculum attuned to the average student; (4) the establishment of graduate schools in a few strong institutions that would receive adequate financial backing; (5) industry to select and pay graduates in accordance with their education and abilities; and (6) the student to secure practical ideas concerning the administration of business along with his technical development.

Waste Elimination Discussed

Of particular interest in the discussion upon the elimination of waste was that concerned with prevention of waste through proper choice and installation of mechanical-handling equipment. This was discussed under the auspices of the Materials-Handling Division of the Society and the chief paper was read by H. V. Coes, manager of Ford, Bacon & Davis, Philadelphia. Mr. Coes proposed a formula which would solve within certain limits the economy of the application of this or that type of materials-handling machinery. Such a formula took into consideration the following variables: Interest charges on investments, interest to provide for upkeep of apparatus installed, interest to provide for (1) depreciation due to age, (2) progress in the art of the particular device proposed, (3) extensions to service, additional superintendence and overhead expenses due to changes in method, and interest to provide for taxes, cost of power supplied and other variable items.

In the discussion that followed Mr. Coes' paper it was brought out that the best service to which the Material-Handling Division of the American Society of Mechanical Engineers could subscribe would be to put in the hands of the public exact information upon the peculiar uses of all kinds of mechanical equipment. It was also asserted that necessity was present for manufacturers of equipment to realize the limitations of their specific devices and that each had a field, but that each was not all sufficient.

One of the proceedings of the meeting was the bestowal upon Hjalmar G. Carlson, a mechanic of Worcester, Mass., of the society's gold medal as a prize for his invention, making possible the production of 30,000,000 drawn steel booster casings to use principally as a component of 75-mm. shells.

The following officers were elected: President, Dean Dexter S. Kimball, Cornell College of Engineering, president; vice-presidents, Col. Edward A. Deeds, Dayton, Ohio; Robert Sibley, San Francisco; Louis Strothman, Milwaukee; managers, Sherwood F. Jeter, Hartford, Conn.; Horace P. Liversidge, Philadelphia; Hollis P. Porter, Tulsa, Okla., and Walter S. Finlay, New York. William H. Wiley of New York was chosen treasurer, and Calvin W. Rice, also of New York, secretary.

Proposed Federal Works Total $73,000,000

President Submits Budget to Congress —$48,000,000 for War Department

Despite the reduction in the federal budget, the appropriations requested for the next fiscal year are practically as great as those appropriated for during the current fiscal year. The budget which just has been submitted to Congress by the President, provides for $73,438,946.67 for public works. This is only $88,463 less than the amount appropriated for the current fiscal year. In fact, there is an increase in the amount requested for public works in each of the departments, except Interior. The reduction is confined entirely to the amount requested for construction work in connection with that department and the Panama Canal.

N. Y. Section Am. Soc. C. E. to Meet Dec. 21 to Discuss Zoning

The meeting of the New York Section, Am. Soc. C. E. to consider the Zoning Law will be held Dec. 21 and not on Dec. 9 as erroneously stated in our Dec. 8 issue.

Tennessee License Board Meets

The Tennessee State Board of Architectural and Engineering Examiners held its regular meeting in Nashville, Dec. 3. Plans for examinations were decided upon and application blanks were approved. Every architect and engineer practising in the state after April 9, 1922, in "responsible charge", will be required to have a license. The board suggests that as many as possible apply early, to avoid a rush of applications when time is limited.

Application blanks and copies of the License Law may be had from any Board member. The chairman of the board is A. L. Dabney, Randolph Bldg., Memphis.

Highway Officials Meeting

(*Concluded from p. 996*)

Commissioner Crawford of Indiana, pointed out the weakness of spending too much for expensive relocation before certain districts had any roads, because it penalized the man on a mud road.

Fred R. White, chief engineer, Iowa, spoke of the numerous relocations in Iowa now being built to obtain unobstructed views at grade crossings. Mr. Rogers said more accidents occurred on "safe" roads in Michigan than on curves and at crossings.

A. R. Hirst, state highway engineer, Wisconsin, indorsed Mr. Sheets' views. In his opinion departments could not go too far in getting proper location.

Thomas H. MacDonald, chief, U. S. Bureau of Public Roads, in answer to a question regarding federal aid for railroad underpasses said that the new law prohibited participation on the theory that the structure was a bridge for the railroad, but that 50 per cent of the cost of overhead structures could be so borne, which would average up on total allowances, since the railroads usually paid for half of such structures. The bureau, he said, was gathering data on cost of operations so as to enable the states to base designs of alternate routes in relocations on actual costs of transportation service rendered.

Road Slab Observations

Warping of Concrete — The striking results of observations on the warping of concrete slabs under temperature and moisture changes were brought out by A. T. Goldbeck, chief, division of tests, Bureau of Public Roads, and Clifford Older, chief engineer, state highway department, Illinois. Mr. Goldbeck analyzed the problem mathematically and showed that the stress at the center line of an 18-ft. slab under ordinary daily fluctuations of temperature, 36 deg. F., approached the modulus of rupture. Mr. Older detailed observations on the Bates 2-mile test road where the daily movement lifted the edges from the subgrade. On this showing he has hinged his pavements at the center, making the slabs 9 ft. wide, doweling them together and running a continuous rod along the edge to support corners at transverse cracks.

A. R. Hirst started a lively discussion by his paper on "Safety and Beauty as Factors in the Layout and Design of Highways." He held that the future of a road is practically decided by the original layout, by its design and by its structures. Some beauty can be secured by preserving natural growthes during construction and also in preparing the plans for a highway. With reasonable precautions vision can be provided and vision is the keyword to safety. A department that is not being severely criticized because of its drastic relocations and treatment of curves and widths is not living up to its responsibilities of leadership in American highway development, Mr. Hirst believes.

Mr. Sheets endorsed center strip markings as a measure of safety. Mr. Rogers favored 500 ft., as against the usual 200 ft., as the distance for placing railroad warning signs. Mr. Bennett said the law providing for mirrors on trucks was of little use in making truck drivers turn to one side to permit a car behind to pass, because the mirror was so soon joggled out of position. F. W. Saar, deputy commissioner, New York, spoke of the safety value of the double-track roads recently constructed with a 6-ft. macadam center strip. (See *Engineering News-Record*, Nov. 17, p. 804.)

Research

In the report of the committee on tests, H. S. Mattimore, engineer of tests, Pennsylvania, chairman, the country is divided into nine districts in which similar limits in specifications may be applied. These districts are: (1) New England States, including New York and Pennsylvania; (2) Ohio, Kentucky, Virginia, Maryland, Delaware and New Jersey; (3) Tennessee, North Carolina, Alabama, Georgia and Florida; (4) The states in the Mississippi Valley Association, Indiana, Illinois, Michigan, Wisconsin, Minnesota and Nebraska; (5) North and South Dakota, Wyoming and Colorado; (6) Kansas, Missouri, Arkansas, Louisiana and Mississippi; (7) Texas, New Mexico and Oklahoma; (8) California, Nevada, Utah and Arizona; (9) Oregon, Idaho, Montana and Washington.

Permission was granted the committee by the convention to prepare standard methods of tests and for each of the nine districts to define limits used in specifications in those districts. Contractors in these districts will not be under the necessity of preparing material under more than one set of specifications. On stone tests a subcommittee has been at work for two years comparing the standard Deval cylinder with a slotted cylinder, the latter being recommended especially in determining the qualities between a medium soft and a very soft rock. The question was ordered sent to letter ballot.

Dean Anson Marston, commissioner, Iowa, spoke of the actual loads on pipes in culverts showing that the stress depends upon the bed and whether the pipe is laid on or below the natural or compacted surface. Specifications and formula recommended were referred to the committee.

Shale particles in aggregate can be removed by jigs, according to a subcommittee progress report, but as yet a commercial plant as projected in Minnesota has not been constructed.

Prof. W. K. Hatt, director, advisory board, highway research, National Research Council, in his paper on "The Co-ordination of Research Work as Carried on by State Highway Departments" urged the recognition of research departments. He made it plain that the function of the board was not to do any work but to act as a clearing house for work under way, proposed or suggested. He called attention to the fact that the highway industry was of 20-billion dollar magnitude, equal to that of the railroads. The frozen assets of research should be liquidated through mediums of a census and publicity.

In discussion, Mr. Mattimore indicated that research was not a cure-all and theory must go hand in hand with practice where the details of construction may be worked out to provide a finished product. He made a strong plea for the continuity of research investigations, regardless of changing personnel.

Future Traffic — J. H. Mullen, chief engineer, Minnesota, analyzed present traffic and predicted a few of the problems of the future. Horse traffic is increasing in numbers, though not in per cent, in the agricultural districts and must be cared for. Formerly the travel limit was 10 miles. Now it is unlimited; 10 per cent of the vehicles passing the 137 census stations in Minnesota carried out-of-state licenses. As to future regulations, he predicted maximum speed limits of 40 miles per hour and minimum limits of 25 miles at certain periods of the days, thus forcing slow-moving vehicles into night and off-peak periods.

Federal-Aid Policies

In his paper on "A Resumé of the Work of the Bureau of Public Roads and Its Projected Policies in Handling Federal Aid" Mr. MacDonald exhibited a striking chart showing the straight-line percentage increases since 1910 of motor vehicles as compared with the very flat increases in road construction and maintenance during the war period. Expenditures both for maintenance and construction have lagged much behind funds available. There is no more important item, in his estimation, than the immediate selection of the federal highway system, in which local traffic is not to be minimized. Other points to be considered are provisions for parallel roads through larger cities, routing trunk lines off heavy local-traffic streets, reconstruction of trunk lines, widening and connections with adjoining states.

The provision for maintenance by federal authorities, Mr. MacDonald hoped, would not have to be invoked. He said, however, that this provision would be enforced to the letter. To make such maintenance satisfactory to the government the states must have some form of patrol constatnly and automatically operative. With this in view he suggested the desirability of the states immediately taking over the designated systems for maintenance. In construction, 18-ft. paved widths are the minimum for two-way traffic. One-half may be built at a time in sparsely settled districts. Old roads should be salvaged to preserve present investments and eventually every grade crossing on the federal system must be eliminated.

New Developments

Of the new developments during the year Charles M. Upham, state highway engineer, North Carolina, indicated that they were confined mostly to details. Reinforcing is becoming heavier; 100 lb. per 100 sq.ft. not being unusual. Concrete materials are generally kept off the subgrade. Richer bases are being used and cured like one-course work. Curing receives much more attention now than formerly. Forms have been too light; heavier ones with a double web are recommended to insure good riding qualities in the completed pavement. Fiber conduits are being placed transversely in some small towns for water and gas mains and electric wires. One new road has been developed, the "subgrade" highway, a sandclay road with all provisions for a future surface. To keep a bituminous oil mat from peeling a thin layer of 1½ to 2 in. stone is rolled into the surface after loosening with a scarifier.

B. H. Piepmeier, engineer of construction, Illinois, in discussion said that during the year 95 contractors operated 102 mixers. On 20 plants industrial haulage was used; 34 had central proportioning plants served generally by trucks; 12 had central mixing

plants; 8 had roadside storage piles 600 ft. to 1½ miles apart. The tendency was toward central proportioning rather than central mixing. Storage over tunnels is losing in favor. Heavier equipment is required. Present equipment design is far behind the requirements of the average road contractor, not in conception but in stability. This, with the attendant breakdowns, is the chief reason why only 300 or 400 ft. is the average day's run. For curing success has attended the use of straw, sawdust, an asphalt cover and calcium chloride. The latter, 4 lb. per yard, is sprinkled on in a rich 1:1 solution. Laboratory tests show an accelerated set as well as increased strength folowing its use.

Maintenance.—W. A. Van Duzer, assistant maintenance engineer, Pennsylvania, described the maintenance organization and how it functions in his state. Finances should be made available in the winter so that budgets may be made up five months ahead of construction. Fixed revenues should be provided in county units with smaller amounts for contingencies. The department handles every complaint, realizing that the road by each man's house is to him the most important in the state. Success is largely dependent on maintaining equipment in good condition.

In discussion, H. G. Hotchkiss, second deputy commissioner, New York, spoke of the development of a heavy surface-treatment binder applied after old macadam had been cleaned thoroughly by hand. W. H. Root, maintenance engineer, Iowa, described the Iowa system which is exactly the opposite of that in Pennsylvania and New York in that it is entirely decentralized, everything being handled by the counties from the district engineers' offices.

RESOLUTIONS

The suspension of the U. S. Bureau of Public Roads' magazine *Public Roads* was deplored. Advertising signs on highways were condemned and the organization pledged itself to support any proper movement to eliminate them. Grade crossing elimination on main roads as rapidly as funds were available was endorsed and the attitude of certain railroads and state utility commissions against such expenditures was condemned. The Federal-Aid Highway Act was endorsed and the organization pledged its aid in carrying out its provisions. House bill 8978 calling for $100,000,000 annually for a 5-year period was endorsed. The Interstate Commerce Commission and the utility commissions were urged to remove the inequalities in freight rates which discriminated against road materials. Assurance was given Congress of the proper use of surplus war material and a request made for the release of 5 and 10-ton caterpillar tractors. States were urged to collect a more equitable proportion of taxes from the vehicle users for construction as well as maintenance. An elimination of partisan politics from highway administration was urged.

Officers.—The officers elected for the ensuing year are as follows: President Charles M. Babcock, Minnesota; vice-president, Charles J. Bennett, Connecticut; secretary, Charles M. Upham, Raleigh, North Carolina; treasurer, Frank T. Sheets, Illinois; directors W. D. Uhler, Pennsylvania, and D. P. Olson, Idaho.

Allegheny County Bond Issues Heavily Defeated

The official count, announced Dec. 7, of the popular vote at the November election on a $27,000,000 bond issue by Allegheny County, Pa., showed a 2 to 1 defeat or worse for each item, the adverse majorities increasing in the following order; roads, new bridges, raising Allegheny River bridges, remodelling courthouse. It was at first proposed to make the bond issue $41,000,000.

B. Welchii a Feature at New Jersey Sanitary Association

A feature of the annual meeting of the New Jersey Sanitary Association, held at Lakewood Dec. 9 and 10, was a discussion on "B. Welchii and the Montclair Water Supply." The opening paper was by M. N. Baker, of the editorial staff of *Engineering News-Record*, who for twenty years was a member of the Montclair Board of Health. The paper was in part a brief of the symposium on B. Welchii in *Engineering News-Record* June 2 and 9 and the article on the same general subject by Sir Alexander Houston in the same journal for Sept. 22, 1921. Mr. Baker concluded that in view of the remarkable general health record of Montclair and the almost complete freedom of the town from typhoid fever, and in view also of the little use of the B. Welchii test throughout the country and the lack of proof that it is a cause of the spread of water-borne intestinal troubles, the ban on the Montclair water supply that has now existed for some nine months is unwarranted.

H. B. Larner, health officer of Montclair, urged that freedom from typhoid does not prove the safety of the Montclair water supply and cited the large outbreak of diarrhea in the town some three years ago as proof, together with the opinions of some of those who contributed to the symposium already mentioned to the effect that a safe water should show no gas-forming bacteria. Mr. Larner also stated that a considerable percentage of the water samples examined almost daily for about a year showed the presence of B. Welchii and a lesser but still significant percentage of B. Coli as well. F. W. Green, superintendent of filtration and pumping, Montclair Water Co., said that the bacterial findings of the company at the filtration plant did not agree with the Montclair laboratory records, but that before reaching the Montclair taps the water passes to and through an open storage reservoir. Dr. R. B. FitzRandolph, chief of the New Jersey State Board of Health Laboratory, stated that a limited number of examinations of 32 different surface water supplies in New Jersey showed B. Welchii sometimes present in all but nine. Cultures from milk supplied Montclair showed B. Welchii in three of seven samples. George W. Fuller, consulting engineer, New York City, gave general support to the engineering conclusions of the paper.

In his presidential address, Dr. R. B. FitzRandolph outlined a health district scheme of public health administration for New Jersey, with special reference to giving the proper service to the smaller incorporated places and the rural townships of the state. A discussion on "Garbage Disposal as it Affects the Municipalities in the Metropolitan District" was opened by James E. Brooks of Glen Ridge.

Discuss Colorado River Power Development

Controversies by Adherents of Public and Private Operation Block Results

At the meeting of the League of the Southwest at Riverside, Cal., Dec. 8 and 9, over 1,000 delegates and visitors listened to papers and addresses on the proposed development for irrigation, power and flood protection of the Colorado River. Controversies between the adherents of public and private water-power operation prevented any definite results.

The purpose of the meeting was to gather the opinion of the states of the Southwest in regard to the mode of procedure for the development of the entire Colorado River and to present this information to the Secretary of the Interior who was present at the meeting and who later conducted the hearing at San Diego on the same subject. A program of over two dozen addresses was presented, covering every phase of the development of the Colorado River basin. Each state in the basin was represented by one or more speakers.

PRINCIPAL ADDRESSES

O. C. Merrill presented a paper on the attitude of the Federal Power Commission. He stressed the point that the development should not be made by an agency that was restricted by state lines, and, while this did not mean government operation, it did mean that the development should be by a single interconnected system which could take advantage of the improved load factor of such a large territory. The attitude of the Southern California Edison Co., which has made filing for power on the Colorado aggregating over 2,000,000 hp. was given in a statement to the effect that the company was ready immediately upon the issuance of permits by the Federal Power Commission vigorously to proceed with this work and that it was in a position to spend from $30,000,000 to $40,000,000 per year in the construction of works which would remove the flood menace and provide power in units sufficient for demands.

Director A. P. Davis, of the U. S. Reclamation Service, stated that no plan of development should be undertaken until the Colorado River Commission, which has been constituted by the several states concerned and one federal representative, has completed its work and allocated the water and benefits to the several states. It is reported that President Harding has appointed Herbert Hoover to be the federal representative on this commission. Secretary Fall said that the government was the only agency that could properly protect the interests of all and that in his opinion the government alone should undertake this work.

SAN DIEGO GOVERNMENT HEARING

At the hearing on the Colorado River held by Secretary Fall at San Diego on Dec. 12 an almost unanimous agreement by the delegates present was given to the policy of government construction and control of a dam on the Colorado River at Boulder Canyon as expressed by Secretary Fall and Director Davis of the Reclamation Service. The hearing was for the purpose of hearing any objections to the plans of Director Davis as reported by him to Secretary Fall on July 8, 1921, under the provisions of the Kincaid Act. It was extended in scope

Indiana Plans Large Highway Contracts

With 80 miles of paved roads constructed in 1921 the Indiana Highway Commission contemplates letting contracts some time after Jan. 1 for from 100 to 125 miles of hard surfaced road. About 66 miles of the new construction will fill gaps in the National Road and complete this highway across the state from Terre Haute to Richmond. Construction on grade and structures is now in progress and is expected to be ready for paving in the spring.

(*Concluded from preceding page*)

to cover any general phases of the development of the Colorado River basin but no general discussion resulted.

The only objections were entered by the states in the upper part of the basin, who were firm in their desire that their rights to the use of water would not be jeopardized by any prior appropriations made in the lower basin or because of a dam or dams constructed below the Utah state line. Former Governor Sloan of Arizona emphatically stated that his state counted on a prior right to power generated therein as such was their greatest natural resource. A statement that the work could well be done by private interests was made by H. H. Craig of the Southern Sierras Power Co. and R. H. Ballard of the Southern California Edison Co. The latter said in part: "In the applications filed by the Southern California Edison Co. for the development of the power possibilities of the Colorado River that the company recognizes that these can be made under such conditions only as will first provide for flood control and irrigation, and that the company will submit to such modification of its plans and to such regulations of its operations as may be imposed by the Federal Power Commission, or other federal authority in the interests of flood control and irrigation."

In presenting an abstract of his final report under the Kincaid Act, Director Davis stated that a strong argument in favor of dams on the upper reaches of the river lay in the freedom from silt of the water in that place but that this was overbalanced by the urgent necessity of having the dam near the Imperial Valley. He claimed that a great waste of water would follow if the dam was near the Utah line as a surplus of water would need to be released in order to assure sufficient for the varying needs for irrigation in Imperial Valley. He stated that the power to be obtained from Boulder Canyon dam was in accordance with the table shown herewith:

Storage in Million Acre Feet	Hundred Thousand Horsepower
Based on 2,020,000 Acres Irrigated in Lower Basin	
21	1.6
22	2.7
28	5.2
37	7.4
Based on 1,500,000 Acres	
13	1.0
20	4.4
26	6.1
37	8.2

Mr. Davis recommended a board of three not resident or interested in states affected, one an irrigation engineer, one a power engineer and one learned in irrigation law be appointed to allocate costs and benefits of the construction works.

Civil Service Examinations

UNITED STATES

For the United States civil service examinations listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Vacancies in the Bureau of Standards, Department of Commerce.

Junior Technologist, $1,200 to $1,500 a year. Examinations to be held Jan. 11, March 8 and May 17.

Junior Engineer, $1,200 to $1,500 a year. Examinations to be held Jan. 11, March 8 and May 17.

Technologist, $2,800 to $4,000 a year. Associate Technologist, $2,000 to $2,800 a year. Assistant Technologist, $1,500 to $2,000 a year. Applications rated as received until further notice.

Engineer, $2,800 to $4,000 a year. Associate Engineer, $2,000 to $2,800 a year. Assistant Engineer, $1,500 to $1,800 a year. Applications rated as received until further notice.

Engineering Societies

Calendar

Annual Meetings

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Convention, Cleveland, Ohio, Feb. 13-16.

AMERICAN ROAD BUILDERS ASSOCIATION, New York; Annual Convention and Good Roads Show, Chicago, Jan. 17-20.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 18-19.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Conference, Cleveland, Ohio, Jan. 17-19.

FEDERATED AMERICAN ENGINEERING SOCIETIES (American Engineering Council) Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 5 and 6.

The American Water Works Association, New York Section, at its meeting Dec. 9, at the Hotel McAlpin, New York, was addressed by Walter E. Spear who will describe the waterworks of Greece and the project of a new supply for Athens, on which he served as consultant.

The Dallas (Tex.) Technical Club, at its regular weekly luncheon, Nov. 7, heard the reports of its employment bureau showing that the bureau had placed 130 applicants and that men were being placed at the rate of six a week. Three city engineers secured positions in one week.

The Engineers' Club of the Lehigh Valley, Bethlehem, Pa., has elected W. O. Hearsey, division superintendent of the Bethlehem Steel Co., as president and W. M. Kelsey, general superintendent of the New Jersey Zinc Co., Palmerton, Pa., as manager.

The Iowa Engineering Society's advisory council Oct. 19 nominated the following candidates for office to be voted upon at the January meeting of the society: President, T. E. Rust, J. G. Thorne, R. W. Crum and C. H. Streeter; vice-president H. P. Streeter, K. C. Kastberg, J. B. Davidson and F. C. Chambers. The council has recommended an increase in dues from $6 to $10 and a provision for sustaining members so that funds may be available for a secretary, paid at least for a part of his time. Co-operation with the architects in obtaining a registration law was recommended.

The Texas Section, Am. Soc. C. E., at a recent meeting, was addressed by E. A. Wood, engineer to the Chamber of Commerce Development Association of Dallas. His subject was "City Planning."

The Engineering Society of Western Massachusetts, at its meeting in Greenfield, Nov. 22, was addressed by C. C. Chesney who read a report on the new million-volt transformer at the General Electric Co.'s works in Pittsfield, Mass., and by O. P. Perin on "Industrial Developments in India."

The Youngstown (Ohio) Engineers' Club, at its meeting Nov. 11, was addressed by James A. Campbell on "The Present Railroad Situation and Its Relation to Business."

The Illinois Society of Engineers will hold its 37th annual meeting, Jan. 24 to 26, at Decatur, Ill. Aerial surveys and land and engineering surveying will be considered at the first session Jan. 24, and sewerage and sewage disposal matters at the second session. On Jan. 25 the papers will be on water supply resources and treatment. There will be an excursion to the new waterworks dam and sewage disposal plant, the evening being assigned to committee reports and a business session. On Jan. 25 one session will be devoted to roads and street paving, and the other to waterways and the legal and engineering aspects of land drainage. The annual dinner will close the meeting.

Personal Notes

JOSEPH WRIGHT, until recently chief of construction, Division 1, at the Wilson Dam, Florence, Ala., has accepted a position with Dwight P. Robinson & Co., Inc., and has sailed for Brazil.

BERTRAM D. DEAN, formerly deputy engineer in the county engineer's office, King County, Wash., has been appointed resident engineer on the inter-county bridge over the Columbia River, between Pasco and Kennewick, Wash.

ROBERT D. SNODGRASS has been made vice-president in charge of engineering of Hamilton & Chambers Co., Inc., New York.

R. M. CONNER, formerly project manager, Fort Peck project, U. S. Reclamation Service, with headquarters at Poplar, Mont., has been appointed construction engineer of the Riverton project, on diversion dam and canals to irrigate 100,000 acres in Fremont County, with headquarters at Pilot, Wyo.

PROF. LOUIS C. MONIN, dean of cultural studies, Armour Institute of Technology, has been granted a leave of absence until Sept. 1922. He sailed from Montreal, Nov. 4 on a trip to Europe.

R. C. E. WEBER, since 1907 with the U. S. Reclamation Service, has been

promoted from assistant engineer to project manager of the Orland project.

WILLIAM B. BAMFORD, consulting engineer, Trenton, N. J., has been elected mayor of Belmar, N. J.

TEVOR J. POWELL of Summit, N. J., has been appointed assistant county engineer of Union County, New Jersey.

H. S. CLARKE, for the past two years division engineer of the Delaware & Hudson R.R., with headquarters at Carbondale, Pa., has been appointed general manager, maintenance of way department, with headquarters at Albany, N. Y.

J. B. AKERS, for 12 years engineer, maintenance of way, for the middle district of the Southern Ry., with headquarters in Knoxville, has been appointed chief engineer, Lines East, Southern Ry., with headquarters in Charlotte, N. C.

E. R. THOMAS has been appointed city engineer of Port Arthur, Tex.

WILLIAM L. REEVES has been appointed city manager of Glendale, Cal.

C. GRAY, who has been acting chief engineer, Indiana State Highway Commission since Sept. 1920, has been appointed chief engineer of the commission.

BENJAMIN BEAN, with the Missouri State Highway Department on highway construction, is now with the Merkle Machinery Co. on installation of water-works and power plant for Duncan, Okla. Benham & Mullergren are the consulting engineers on this work.

WILLIAM N. ELSBERG, assistant city engineer, has been chosen by the City Council as city engineer of Minneapolis. He graduated from the University of Minnesota in 1910, and since 1911 has been in the Minneapolis city engineering department on sewer and bridge work except while serving in the civil engineer corps of the navy in 1918-19. Recently he has been in charge of construction of the Third Ave. bridge, Minneapolis.

GEORGE B. HILLS has just established the George B. Hills Co., engineers, Jacksonville, Fla., successor in the South to Isham Randolph & Co., specializing in drainage, docks and terminals and structural design. W. O. Sparklin, structural engineer and architect, lately of Washington, D. C. is now associated with this office.

H. G. SOURS, deputy county engineer, Summit County, Ohio, has been appointed resident state highway engineer for Summit County.

O. J. BROOKSHIRE has been appointed city engineer of Lebanon, Ind.

S. UCHIYAMA, chief engineer, city planning commission of Osaka, Japan is in this country to make a four months' study of the parks and public grounds in Chicago, Cleveland, St. Louis, Kansas City, Washington and Boston.

R. F. HEILLAND, for two years city engineer of Waxahachie, Tex., has entered into partnership with his father, Hans Helland, city engineer of San Antonio, Tex., forming the engineering firm of Helland & Helland, with office in San Antonio.

G. W. COURTER of Marshall, Tex., has been appointed engineer for Palo Pinto County to supervise the construction and maintenance of the Palo Pinto County's portion of the Bankhead Highway and 40 mile of lateral county roads.

W. W. KELLEY, formerly division engineer, Atchison, Topeka & Santa Fe Ry., with headquarters at San Bernardino, Cal., has been appointed engineer of the Grand Division, with headquarters at Los Angeles, Cal.

T. MARTIN has transferred from the position of division engineer Revelstoke division, Canadian Pacific Ry., to division engineer of the Nelson Division, at Nelson, B. C.

D. W. MURPHY, consulting engineer, Los Angeles, has been appointed consulting engineer on drainage for the Imperial Valley Irrigation District. Mr. Murphy was for many years connected with the U. S. Reclamation Service, where his work dealt largely with studies of relief from troublesome ground water in irrigated lands. In his work in the Imperial Valley he is to handle problems of a similar character.

DR. K. G. MATHEWSON has resigned the presidency, Georgia School of Technology to accept the presidency of Drexel Institute, Philadelphia, effective April 1, 1922.

OBITUARY

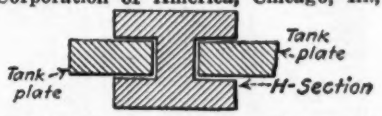
SEBASTIAN WIMMER, engineer, died recently at St. Vincent, Pa. He was born in Bavaria in 1831 and came to America in 1851. His experience in railroad construction work dates back to 1854 when he became connected with the Allegheny Valley R.R. as assistant engineer. Entering the service of the Pennsylvania R.R. in 1861, he was appointed in 1865 to take charge of a portion of the construction of the Imperial Mexican Ry., and for three years he was engaged in this work with headquarters at Maltrata. In 1874 he was elected to the Pennsylvania legislature, serving two years. Later he was chief engineer on the construction of the Pittsburgh & Lake Erie R.R., constructed the New York City & Northern R.R., now a part of the New York Central system, and the Yonkers Rapid Transit railway from Van Cortland Park Park to Gettys Square, Yonkers, N. Y.

LORD MOUNT STEPHEN, railroad constructor and first president of the Canadian Pacific Ry., died Nov. 30 at his country residence, Brocket Hall, Hatfield, Hertfordshire, England. He was born at Forres in Banffshire, Scotland, in 1829, went to Canada in 1850 and entered the store of his uncle in Montreal, a cloth merchant. He later came into business relations with Donald Smith, afterward Lord Strathcona, who interested him in the construction of a railway to the Canadian West. They joined forces with the late J. J. Hill and acquired the St. Paul & Pacific R.R. and the line was built through from St. Paul to Winnipeg, which made possible the subsequent building of the Canadian Pacific Ry.

EQUIPMENT AND MATERIALS

Cast-Iron Tanks for Dry Materials

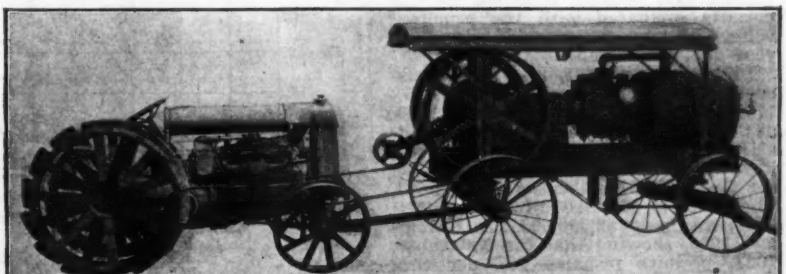
Cast-iron tanks for storing dry materials of any sort ordinarily stored in bins are being made by the Conveyors Corporation of America, Chicago, Ill.,



for installations where resistance to abrasion and rust and low maintenance costs are especially important. The tank is made of ¼ in. x 2 x 2 ft. radius plates held between cast iron verticals of H-section. It is set on a concrete slab floor and can be elevated and provided with bottom discharge openings in any manner desired.

Tractor-Driven Portable Compressor

For light rock excavation in trenching and road grading, a portable air compressor outfit has been devised by the Sullivan Machinery Co., Chicago. It consists of two units: a steel truck



carrying a compressor and receiver and a small tractor which drives the compressor by a belt and also hauls the outfit from place to place. This outfit will operate one rotator or hammer drill, using ¾-in. hollow drill steel, and capable of drilling holes as deep as 16 ft.

The compressor is of the horizontal single-stage type, but with a hopper or open jacket instead of the usual closed jacket for the cooling water, thus dispensing with a circulating pump. The jacket is filled by means of buckets or a hose. With a speed of 260 r.p.m. the compressor has a displacement of 121 cu.ft. of free air per minute and gives a 90-lb. pressure, requiring 18 hp. to operate it for this pressure. In line with the air cylinder is a receiver 26 x 33 in. The weight of the compressor unit, with cooling jacket empty, is a little over 4,000 lb.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Engineering News-Record's Cost Index 1917 to Date

Engineering News-Record's Construction Cost Index Number is here tabulated monthly from January, 1917, to December, 1921, inclusive. The chart on this page includes this Number from 1918 to date. The Index Number for the months of 1916 will be presented here next week.

ENGINEERING NEWS-RECORD
CONSTRUCTION COST INDEX
NUMBER
(100 in 1913)

	1917	1918	1919	1920	1921
January	167.75	184.51	198.05	206.55	230.87
February	167.75	184.51	201.50	225.10	230.67
March	175.66	184.51	198.05	240.85	224.27
April	183.41	186.01	191.25	265.20	213.07
May	187.61	186.01	191.25	268.90	210.82
June	199.26	186.31	191.85	273.80	209.82
July	204.01	188.65	193.65	265.65	203.82
August	198.41	193.85	196.65	252.00	193.07
September	190.31	193.85	202.85	255.20	188.27
October	167.11	193.85	202.25	255.20	182.57
November	166.51	193.55	206.85	255.32	166.32
December	167.11	194.75	206.85	251.62	167.82

E. N.-R. Cost Index Converts Permits into Volume

One of the chief applications of *Engineering News-Record's* Construction Cost Index Number is to place current construction on a 1913 purchasing basis, so that the actual volume may be compared with the volume in a similar period in 1913. This, by the way, is the computation of the *E. N.-R.* Construction Volume Index Number. By the same process current valuations of building permits issued may be converted into 1913 terms, and the current construction volume promised by the permits compared with the promised volume of some other period—with one year ago, for example.

In November, 1921, Los Angeles issued 4,242 permits valued at $8,685,775, against 2,640 in November, 1920, at $6,267,660. To place these two valuations in terms of comparable volumes it is only necessary to divide each by the Cost Index Number for that period. The result is, $5,170,000 for November, 1921, and only $2,490,000 for November, 1920, showing that the November, 1921, permits promise 107 per cent more actual construction volume than those issued in November, 1920.

Large Building Contracts Let

Among this week's announcements of contracts awarded in Construction News, pp. 259@268, are the following large building projects: A 15-story apartment hotel in New York, to J. G. Siegel, New York, $1,400,000; an 8-story apartment hotel in Rocky River, Ohio, to Crowell & Little Construction Co., Cleveland, $1,500,000. There are three $2,000,000 building contracts: a hotel and theatre project in Akron, to W. Dunbar Co., Cleveland; a 21-story office building in Philadelphia, to Metzger, Fisher & White; a 14-story hotel for Cincinnati, to Wells Brothers Construction Co. Plant for the Globe Portland Cement Co., Dubuque, Iowa, will be built by H. C. Strucher, St. Paul, $2,000,000.

Status of Criminal Cases Against Building Material Men

Trial of seven corporations and eleven individuals, members of the Eastern association of terra cotta manufacturers, indicted for violating the anti-trust provision of the Sherman act in the Federal court for the Southern district of New York, has been set.

Four of the defendants in the federal case against the tile manufacturers in the New York district, found guilty of violating the Sherman law, have begun their terms in jail. Three of these defendants received terms of four months and fines of $4,000 and the fourth a two months' jail sentence and a fine of $4,000. There were 62 defendant companies in the indictment against the tile men, 53 of the defendants entering pleas of guilty. Total fines against them were $126,000.

No date has as yet been set for pleading the cases against the hand-blown window glass manufacturers, 104 corporations and individuals engaged in that trade having been recently indicted for violation of the Sherman anti-trust law.

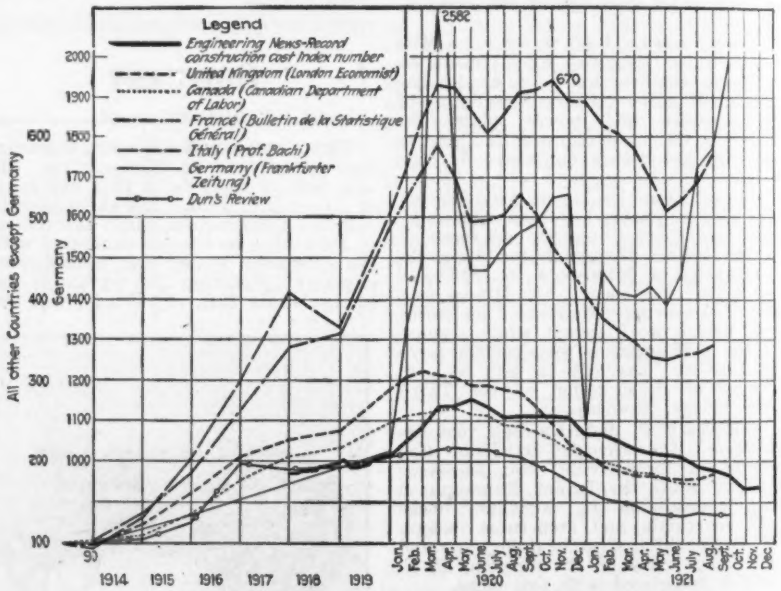
In the New York State Court, the prison terms given four defendant marble men, who formed a small part of number indicted for a violation of the state's anti-trust laws, have been suspended and the defendants put on parole for a period of three years, during which time it may be possible to commit them to jail for an indefinite period should they again engage upon the practices for which they were indicted.

All these cases have grown out of evidence adduced at the investigation of housing conditions in New York by the Lockwood joint legislative committee on housing.

Index Numbers of America and Europe Compared

Showing Increased General Costs—The Price of War—Construction Costs in United States

The accompanying chart shows the economic result of the war in Europe and the United States. Words are hardly needed. In addition to the European, Canadian and American index numbers, the *Engineering News-Record* Construction Cost Index Number is plotted. Economic conditions are bad in the following order: Germany, Italy, France, England, Canada, United States. Dun's Review shows all commodities, in the United States, to be 34 per cent above the 1913 figure; Bradstreet's increase is 21 per cent. *Engineering News-Record* shows general construction cost to be 66 per cent above the 1913 level.



AMERICAN AND EUROPEAN PRICE MOVEMENT

Bids Wanted on Big Jobs

Among the projects on which bids are either being asked or will soon be called for in Construction News, pp. 259@269, are the following:

Sewerage system for Springwells, Mich., $1,250,000.

Buildings for Johns Hopkins Hospital, Balimore, $1,100,000.

Three buildings for Western University, London, Ont., $2,000,000.

Warehouse project at San Francisco, $2,500,000.

Additions to State capitol, Sacramento, $3,000,000.

Extension of Temiskaming & Northern Ontario Ry., from Cochrane to New Post, Ont., $3,000,000.

Next Week—Six Salient Points of the New Tax Bill.

Lumber Freight Reductions

Freight rates on fir lumber from Washington, Oregon and California to New York and New England, which were 80 cents per 100 lb. before the freight rate increases of August, 1920, and $1.06½ after those increases went into effect, will now be 90 cents, according to the National Lumber Manufacturers Association.

Under the $1.06½ rate, on the basis of 2,500 lb. as the average weight per M. ft. b.m., $26.62½ was the approximate average cost of transporting by rail a thousand feet of lumber from the west coast points to the New York and New England territory. The cost of transportation will now average about $22.50 per M. ft. The freight cost to the Cincinnati-Detroit district will be 85 cents per 100 lb. or about $21.25 per M. ft. from west coast points, and 88½ cents, or about $22.12½ to the Pittsburgh-Buffalo territory. The new schedules for Spokane, Montana, Eastern Oregon, etc., give 3c. per 100 lbs. less than the coast rates to the various eastern districts.

Freight Rates on Scrap Higher than on Pig Iron

In comparing Pig Iron and Scrap Iron rates between producing and consuming points, it is noticeable that in most cases scrap pays the higher rate. The scrap rates are not only higher, but much higher. For instance, from Birmingham to Cincinnati the pig iron rate is $4.50 per gross ton, and that of scrap $5.745, or a difference of 28 per cent. From Chicago to Moline, the pig iron rate is $1.96, scrap $2.66, or a difference of 35 per cent. From Cleveland to Toledo, the rate on pig iron is $2.52, scrap $2.94, a difference of 17 per cent.

Handlers of the material claim that inasmuch as scrap always sells at a lower figure than pig iron—in the case of some grades as much as 75 per cent lower—the market value of scrap should be taken into account in establishing the freight rate basis.

Steel plants consume much of the pig iron at producing points, but scrap usually requires shipment by rail. At present it is impossible to move scrap any considerable distance, as the transportation charges are too close to the selling price to permit long hauls; rates in many instances range from $6 to $12 per ton.

Steel Works Planned for India

According to information received from U. S. Department of Commerce, there has recently been registered in India the United Steel Corporation of India, Ltd., with a capital of approximately $60,000,000 to $100,000,000, depending upon the exchange calculated. The registration is in the name of the firms of Messrs. Bird & Co. of Calcutta and Messrs. Cammell, Laird & Co. The latter firm is acting as technical adviser to the corporation and is responsible for the design, erection, and staffing of the works. The plans of the new works are already well advanced. The plant is designed to produce 600,000 to 700,000 tons of pig iron, and the steel works and rolling mills will be capable of producing 450,000 tons of finished steel per year. As a first step, however, it is proposed to erect a unit capable of dealing with half these quantities, and the subsequent development will only be undertaken as occasion demands.

Industrial Machinery Division Embraces Wide Field

The industrial machinery division of the Department of Commerce, recently organized to promote good business methods and to increase exportation in the machinery trade, is more or less directly connected with 4,000 factories in the United States producing industrial machinery, says a recent news dispatch from the Department of Commerce. The value of the products of these factories exceeds $2,200,000,000 per year, of which about 17 per cent is exported. The Department of Commerce believes it is easily possible to increase to a much larger total the export trade because the Bureau of Foreign and Domestic Commerce can do more than has been done to assist the individual manufacturer in developing his foreign business. The foreign business now amounts to approximately $1,000 per employee.

Trend of Business

Bonds—Principal strength in municipals, with general trading declining probably due to tightening money market.

Stock Market—Reaction due to profit-taking on the part of those who won in the rise in the previous week. Conditions do not warrant expectation of a sound forward movement before Jan. 1.

Money—Call loan rates stiffer, ranging from 4½ to 6 per cent. Sufficient time money available.

Foreign Exchange—Dec. 10 Sterling reached $4.105, which was the highest since Nov. 15, 1919. All exchanges rose.

Iron and Steel—Pig iron production for November was 1,415,481 tons, against 1,246,676 in October. Steel ingot production was 1,660,001 tons; 1,616,810 in October, for the thirty companies reporting to the American Iron and Steel Institute. Total steel production averaged 45 per cent, against 44 in October, 32 in September, 30 in August, 21 in July. Consumption is fair except in the construction and machinery industries.

Fabricated Steel Freight Cost

The Bridge Builders and Structural Society, New York City, has found that at the present selling price of fabricated structural steel freight amounts to about 40 per cent. Fabricated steel today is selling at not more than 50 per cent over the average price of 1914, runs the report, while freight alone is more than 100 per cent over the 1914 cost. The fabricator has reduced his labor and other cost items and is now "sacrificing a part of his overhead charges in his efforts to meet the demand for lower prices. The item of freight alone is unchanged."

Recognizing the need for readjustment of freight costs the society adopted a resolution which it has sent to various railway associations and officers of the government having to do with railway and labor matters, embodying the thought that only through a correct relationship between freight and other cost items can there be proper improvement in business conditions.

Economic Paragraphs

Wholesale prices in Canada, the United Kingdom and France also declined during October but continued inflation increased the price level in Germany and Italy.

Increased buying is reflected by greater sales in October by mail-order houses, and chain stores, greater advertising in magazines and larger postal receipts.

The surplus of idle freight cars was cut in half during October, largely due to the threatened railroad strike, and car shortages increased, especially for coal cars. Bad order cars were reduced and total car loadings increased, especially coal and merchandise.

"Personnel Research Agencies" is the title of a bulletin just issued by the United States Department of Labor, through its Bureau of Labor Statistics (No. 299). It is intended to serve as a guide to organized research in employment management, industrial relations, training, and working conditions.

Calculations made by the "Survey" of the Department of Commerce show that the monthly export trade of the United States for the past six months is greater than in 1913, even making an allowance for an increase of 50 per cent in prices. On that basis, exports are 10 per cent greater than the 1913 average but imports are 10 per cent less.

Foreign Commerce of the United States in the first ten months of 1921 totaled $2,060,790,841 for imports and $3,895,791,358 for exports, as against $4,691,214,922 imports and $6,831,201,222 exports in the corresponding period of 1920, according to the Department of Commerce.

Increased employment is shown by the United States Employment Services report covering November in the following industries: paper and printing; lumber and its manufacture; vehicles for land transportation; iron and steel and their products; tobacco manufactures; chemical and allied products; stone clay and glass products; textiles and their products; metals and metal products. Decreased employment was shown in the liquor and beverage industry, in railroad repair shops and in the food and leather industries. While there were employment increases in 40 of the 65 cities, the total unemployment throughout the country increased largely due to seasonal and climatic conditions.

As compared with the average in the year 1913, the retail cost of food on Nov. 15, 1921, showed an increase of 59 per cent in New York and Washington; 57 per cent in Manchester; 54 per cent in Baltimore; 52 per cent in Philadelphia; 46 per cent in Atlanta; 42 per cent in Little Rock; 41 per cent in Denver; and 40 per cent in Louisville. For the year period, Nov. 15, 1920, to Nov. 15, 1921, there was a decrease or 24 per cent in Louisville, Norfolk, Peoria, and Springfield; 23 per cent in Atlanta, Baltimore, Denver, and Little Rock; 21 per cent in Manchester, Philadelphia, Rochester and Washington; and 19 per cent in New York, according to Labor Statistics.

New Railroad Shop-Craft Rules Become Effective

The new shop-craft rules, promulgated by the United States Railroad Labor Board, and affecting approximately 450,000 railroad employees, became effective December 1. Estimates of the Board's statisticians are that the new regulations will effect a saving of about $50,000,000 a year.

Of the new rules, 99 were lifted from the existing national agreement almost word for word, while only 37 have any marked changes in them. The rules which supplant the national agreement are to be applied where the carriers and their employees have failed to agree on new rules. The Labor Board figures that about 60 per cent already have been agreed to between management and men.

Among the typical changes are that the machinists working on repairs may disconnect any wiring, coupling or pipe connections necessary to make repairs, this work having previously been assigned to electricians and sheet metal workers. Under the new rules, too, engineers, firemen and cranemen are not prohibited from making repairs to equipment on the line, if they are qualified to do this. The new agreement also recognizes the open shop principle. Though the railroads have never been strictly closed shop in theory, both union and non-union employees have made their demands through union organization leaders.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of December 1; the next, on January 5.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.78	$4.00	$4.00	$2.88	$3.06	$3.75	$3.45	$3.75	$4.00
Structural rivets, 100 lb	3.50	5.25	5.50	3.43	4.15	4.25	5.50	4.25	6.50
Reinforcing bars, ¾ in. and larger, 100 lb	2.68	3.20	3.50	2.68	3.08½	3.57½	+3.00	3.75	2.75
Steel pipe, black, 3½ to 6 in. lap, discount	54%	57.65%	45%	57%	58.9–5%	38%	51.8%	50%	35.10
Cast-iron pipe, 6in. and over, ton	47.30@48.30	45.00	54.30	44.10	47.80	52.00	50.00	55.00	60.00
Concreting Material:									
Cement without bags, bbl	2.30	2.69	2.55	1.97	2.26	3.10	2.84	3.10	3.16
Gravel, ¾ in., cu.yd	1.75	1.85	2.25	+2.00	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd	1.00	1.25	2.25	+2.00	.50	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.80 to 1.90	2.00	3.20	1.60	2.25	3.50	2.25	3.00	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	+49.00	38.00	−34.00	48.00	35.00	50.00	+30.00	+22.50	120.00
Lime, finishing, hydrated, ton	16.99	19.00	25.00	18.00	29.00	30.00	22.00	27.00	21.00
Lime common, lump, per bbl	3.39@3.69	1.50	2.75	1.40	1.40	2.95	1.90	3.25	11.00
Common brick, delivered, 1,000	17.40@18.40	9.00	12.72	11.00	17.00	14.00	−15.50	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.0675	+.13	.0821	.0792	.09	.12½	.10	.08@.29
Hollow partition tile 4x12x12, block	.11120	.0675	+.13	.0657	....	.10	.14½	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	.72	+.80	+.88	.74	.80	.90	.83	.79	.85
Common Labor:									
Common labor, union, hour	.75	.35	.....	.72½	.50	.50@.55	.75	.50@.60	.....
Common labor, non-union, hour	.....	.20	.35@.45	.35@.40	.50	.35@.40	.50@.55	.50	.25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent, 45@50 means a range of 45 to 50 per cent. Charge of 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over. **New York** quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement delivered to contractors on job. **Chicago** quotes hydrated lime in 50-lb bags; common lump lime per 180-lb. net. **Minneapolis** quotes on fir instead of pine. Brick and hollow tile delivered. Cement on cars; $2.45 delivered. Gravel, sand and crushed stone quote at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net. **Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net. **Dallas** quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. **Seattle** quotes on Douglas fir instead of pine. Lump finishing lime per 180-lb. net. **Montreal** quotes sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile, per ft. Cement price is in Canadian funds (the Canadian dollar stands at 91.2 cents). Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

Changes Since Last Week

The most conspicuous price advances of the week are in lumber, reinforcing bars, sand, gravel, hollow tile and linseed oil in six of the important centers listed above.

San Francisco reports an advance of 10c. per 100 lb. in reinforcing bars and a rise of $1 per M ft. in pine lumber, but quotes a reduction in common brick to $15.50 as compared with $18 per 1,000, one week ago. Both sand and gravel are quoted in Chicago at $2 as against $1.65 per cu.yd. Dallas quotes a rise of 3c. per gal. in linseed oil and a slight advance in hollow wall tile. Atlanta also reports an increase in the price of linseed oil to 80c. as compared with 79c. per gal. last week.

Long leaf yellow pine, base sizes, is quoted in the New York market at $49 per M ft., b.m., delivered. Douglas fir has advanced 50c. per M ft. all along the line in Seattle, with import and export demand increasing.

One hundred and two mills reporting to the West Coast Lumbermen's Association for the week ending Dec. 3, show 60,218,037 ft. of lumber manufactured; 46,172,192 ft. sold and 55,395,960 ft. shipped. Production at mills was only 18 per cent below normal.

Nineteen cement manufacturers in the eastern states, reporting under date of Nov. 30, show that 2,422,000 bbl. of cement were produced during November, 1921, as against 3,032,000 bbl. for November, 1920. Shipments during November, 1921, amounted to 1,537,000 bbl. as compared with 2,602,000 bbl in November, 1920. Reports of stocks on hand show 2,730,000 bbl. on Nov. 30, 1921; 1,846,000 bbl. on Oct. 31, 1921, and 1,180,000 bbl. as of Nov. 30, 1920.

Winter reserve stocks of Hudson River brick, in the New York district, are also unusually large for the season, even considering the most favorable weather conditions; wholesale quotations reaching the lowest point since the 1920 peak.